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[OFFICIAL NOTICE.]

Bound Volume, Proceedings New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Oct. 26, 1901.

A limited number of copies of the "Proceedings" of the New England Association of Gas Engineers, for the years 1900 and 1901, remain, and single copies can be obtained on application to the Secretary, who will mail them on receipt of $2.

This volume contains several papers and the discussions thereon, and are of especial value for reference. The "Proceedings" of prior years will be published later, and the volumes will be of great value for any gas man's library. N. W. GIFFORD, Secretary.

BRIEFLY TOLD.

AN ECHO FROM THE OIL STORAGE TANK EXPLOSION, NEWARK, N. J.—During the afternoon of September 26th last, while workmen in the employ of the Essex and Hudson Gas Company of Newark, N. J., were engaged in changing the connections of an oil storage tank on its plant, certain of them were overcome by inhaling noxious vapor. The men affected were in the interior of the vessel, and their presence there was in direct conflict with the general orders under which operations of a similar nature are conducted on the works. The rescuing plans for the taking out of the asphyxiated ones were directed in reckless fashion by an under foreman, and the result was an explosion that caused the loss of several lives and considerable property damage—the under foreman was one of those who paid the extreme penalty. Amongst the matters investigated by the last grand jury for the district was this tank explosion, and the findings in regard thereto are here submitted—the inquiry was conducted with great deliberation and thoroughness—without further comment: "An investigation was made to ascertain the cause of the explosion of one of the oil storage tanks of the Essex and Hudson Gas Company. It appeared that an under foreman with two men undertook to break certain pipe connections on the inside of the tank. While in the tank they were overcome by gas. Every effort to get them out through the manhole failed. An attempt was then made to rescue them from the outside by cutting through the crownpiece of the tank. During the progress of this undertaking the explosion occurred. From the evidence presented the Grand Jury is thoroughly satisfied that the cause of the accident was brought about by the overzealous desire of the under foreman to accomplish the work in a speedier manner than by the method previously adopted in similar undertakings; that it was done without orders or knowledge of the Company's Manager, and that in the unfortunate attempt to rescue the men in the tank all care and precaution was used."

CHANGES IN THE WESTERN GAS CONSTRUCTION COMPANY.—We are informed that Mr. O. N. Guldlin, President and Engineer of the Western Gas Construction Company, of Fort Wayne, Ind., has purchased the interest hitherto held by the Messrs. Lloyd in that concern. Mr. Ernest F. Lloyd, heretofore Secretary of the Company, has resigned from its service, and, with his family, will shortly leave for Detroit,

LIBRARY OF CONGRESS. DEC 23 1901 441274 SMITHSONIAN DEPOSIT.

which, if we mistake not, is his home place. These changes in no sense affect the business policy of the Company, which, since its formation in 1888, has been directed by Mr. Guldlin. The whole transaction means that a good price was offered for the Lloyd interest and that it was accepted.

MR. GODFREY L. CABOT ON THE BY-PRODUCT COKE OVEN QUESTION.—Mr. Godfrey L. Cabot, of Boston, Mass., a well-known manufacturer of "carbon black," in the States of Pennsylvania and West Virginia, writing to the JOURNAL under date of the 18th inst., sends the following argument anent the subject named in the heading:

To the Editors AMERICAN GAS LIGHT JOURNAL: I have read with great interest the article[1] on "Retort Ovens," etc., by Mr. Thomas Littlehales, for I have been interested in that matter for something like 20 years. I visited one of the earliest by-product coke ovens in existence (1884), and felt ever since it was merely a question of time when most of the coke in the world would be made from such ovens. There is an adequate use for all the by-products that could be made if all the coke of the world were gained from by-product ovens. The ammonia would enrich our fields; the gas would generate power to run our factories and supply heat and light in our houses; the tar would be used partly to supply us with pitch, dyes, varnishes, etc., and partly for fuel. But, with regard to the the question of "Bringing Mahomet to the mountain," this seems to me to have an application a little different from that deduced by Mr. Littlehales. Suppose you were to move all the coke ovens to the place where all the by-products, and especially gas, could be utilized—namely, to our large cities—the coal for these ovens would have to be handled twice instead of once before it reached them, and this double handling, plus the freight from the mines to the coke ovens, would mean an enormous expense. The best market for most of this coke would be on metallurgical account, and it would be a great waste of freight to carry the whole weight of the coal to the cities, and then 7-10ths of the weight from the cities to the nearest iron works, when you could instead carry the coke in the first instance to the nearest iron works. The only important by-product that cannot be worked up into a compact and merchantable form, or utilized direct at the mine, is the surplus gas amounting, according to Mr. Littlehales, to 4,000 cubic feet per ton of coal converted. This gas can be transported, from any point at which coke is made in large quantities, and delivered to consumers at a small cost through pipe lines. Wrought iron pipe properly laid, as much as possible on the surface of the ground, properly varnished and maintained free from rust on the outside, is protected on the inside from rust by the gas. There is no known limit to the time such pipe will last. If buried in clayey soil, which is the nature of the soil in most places where coke is made, such pipes will last certainly 30 or 40 years without renewal. In bad soil it is possible to protect them permanently by swathing them in cloths dipped in melted pitch, precisely as the mummies were swathed; but it would, of course, not be necessary to make the layers so numerous. This somewhat troublesome mode of protection is only necessary in bad soil, of which there is comparatively little in the coke regions of the United States. I am transporting daily to my factories between 8 and 9 millions cubic feet of gas per day, and the cost to me of transporting this gas is much less than one-tenth cent per 1,000 cubic feet per mile. The only additional cost to the manufacturer of gas would be that of pumping. Three per cent. of natural gas will compress in adequate pumps, such as the Standard Oil Company is using at Halsey's station, the remaining 97 per cent. to a pressure of 300 pounds, which is more than sufficient to carry coke gas from any point of large production to places where it can all be used. Suppose the coke gas had only one-half the calories of natural gas, the general proposition nevertheless still holds that, on a sufficiently large scale, such as is well within the power of the larger coke companies, there is an absolute certainty of profit in making coke where it is still made and in transporting the gas in pipe lines to points of consumption. Small coke plants in isolated places might find it more advantageous to move to cities or to continue their present wasteful methods, but that the transportation of gas from coke making regions to large cities is going to be an important feature of industrial distribution in the present century is an absolute certainty. Regarding the very interesting discussion on the relative economy of making gas in retorts or retort ovens, in my plan that question fades away. It is not a question of making gas by one of two methods, but it is a question of making or utilizing gas that must be made, and which if not used will go to waste; and there are certainly many cities in which gas cannot be made as cheaply as it can be delivered from adjacent regions where otherwise it would go to waste.

1. JOURNAL, *ante*, p. 767.

[Continued from Page 967.]

The Vienna Municipal Gas Works.[1]

Gasholders and Gasholder Houses.—The original plans of Herr Herrmann for these gas works included the erection of 4 inclosed gasholders, each of about 3,200,000 cubic feet capacity, closely adjacent to one another. Two out of three advising experts supported these plans, except that they recommended a greater distance between the holders than Herr Herrmann had proposed. But, as it was of the utmost importance to start the work of construction without delay, his plans were adopted without modification, except that the holders have been erected in pairs, with a considerable space between the pairs, instead of all standing at equal intervals in a row. The four large works' mains have been carried through the intervening space between the pairs to the governor house.

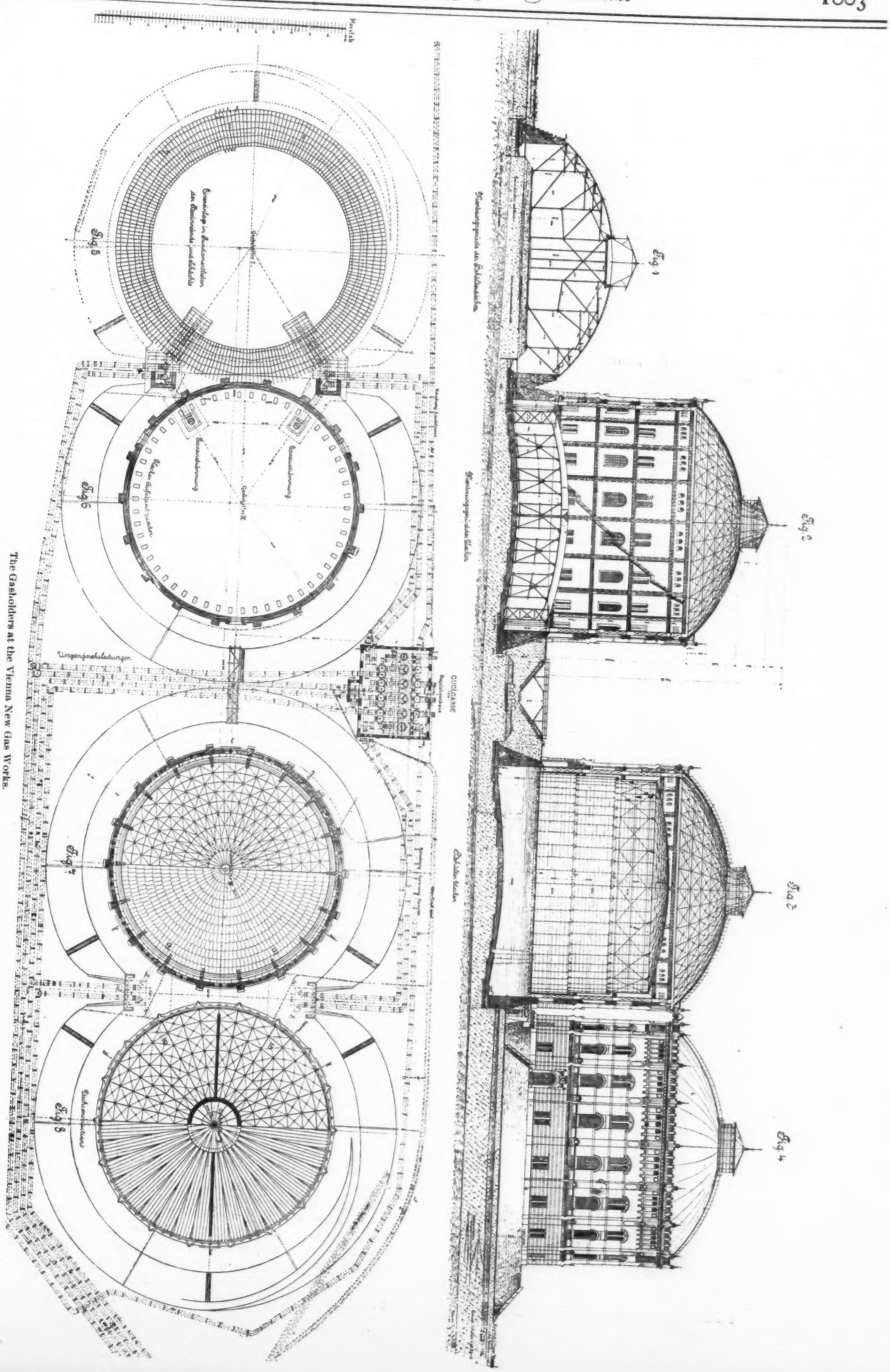
In the construction of these huge and conspicuous holders, it was considered necessary to make them architecturally as little offensive as might be to the artistic sense of the people. For the sake of speed in their construction and of economy, stonework was employed only where unavoidable. The mouldings were chiefly carried out by Monier work; and even the resting blocks in the tank for the bell of the gasholder were of concrete. The water in the tanks was to stand over 26 feet above the raised level of the works; and fears were openly expressed that it would be impossible to insure the soundness of the tanks, especially as the contractors for the work refused to guarantee it in this respect, in view of the short time at their disposal. As the area of the tanks was about 33,300 square feet, and they each held 6,600,000 gallons of water, the filling of them was freely stated to be attended with great risk to the neighborhood. Fortunately, these fears all proved to be groundless, thanks to the care exercised in the design and execution of the work.

The internal diameter of each tank, and of the gasholder house erected thereon, is 206 feet. The walls of the tanks are 39 feet 4½ inches high, and are of brickwork. Ordinary hand moulded bricks and Portland cement mortar were used. The foundations of the walls, the bottom of the tank, and the bed of the wells for the inlet and outlet mains were made in concrete (see Figs. 1–36). The bottom of the tank is horizontal for a width of 9 feet 10 inches from the walls; and in this ring there are 54 resting stones for the bell, formed of concrete and iron. The upper surface of the rest of the tank bottom is dome shaped, with a rise of 8 feet 6 inches. The under surface of the tank floor is, however, made in horizontal steps, in order to avoid any lateral thrust on the wall of the tank. The lining of the tank floor is 5 feet 3 inches thick in its thinnest parts. The walls and the floor of the tank are made water tight by means of a rendering of carefully ground Portland cement mortar 1.2 inches thick. The foundation of the tank walls is 5 feet 7 inches deep. The concreting was executed in 3 stages—viz., first, the foundation of the tank walls for a width of 25 feet; second, the dome of the tank floor; and, lastly, after the house had been finished, the remainder of the tank floor between the walls and the dome. The tank walls are 17 feet 8½ inches thick at the bottom, and diminish by 9 sets-off to 5 feet 3 inches at the top. They are strengthened by 4 sets of polygonal bands of flat iron, ¾-inch by 2.6 inches.

The site of the gas works lies on a former basin of the Danube, which, in the course of centuries, washed trenches out in the marl, and afterwards refilled them with different kinds of materials. Hence there is no uniformity in the subsoil. Compared with the rest of the works, however, the holders, with the exception of No. 2 at one spot, had relatively good subsoil, as on top of the marl there was a firm bed of grey gravel and sand. The foundations were therefore only carried deep enough to give a firm bed of ballast at least 6 feet 6 inches thick from the highest level of the marl. The mean depth of the excavations was therefore 17 feet, and at the wells for the inlet and outlet mains 31 feet 6 inches. Though these depths allowed a good deal of the work to be done in the dry, yet extraordinary difficulty was found in getting the best of the water, especially in the wells for the mains. Great care was taken to avoid the withdrawal of fine sand with the water. Herr Herrmann had proposed to employ an extensive system of piles in order to secure a firm foundation; but this scheme was abandoned in favor of one of bedding in the lower part of the 5 feet 7-inch thick concrete foundation, and of the adjoining horizontal part of the tank floor, two crossed sets of I-shaped girders, 5½ inches deep. The tanks were carefully examined in the short time intervening before the erection of the houses was started, with very satisfactory results. It was found that 1 tank could be emptied without affecting the two adjacent ones.

The walls of the gasholder building above the tank are made with

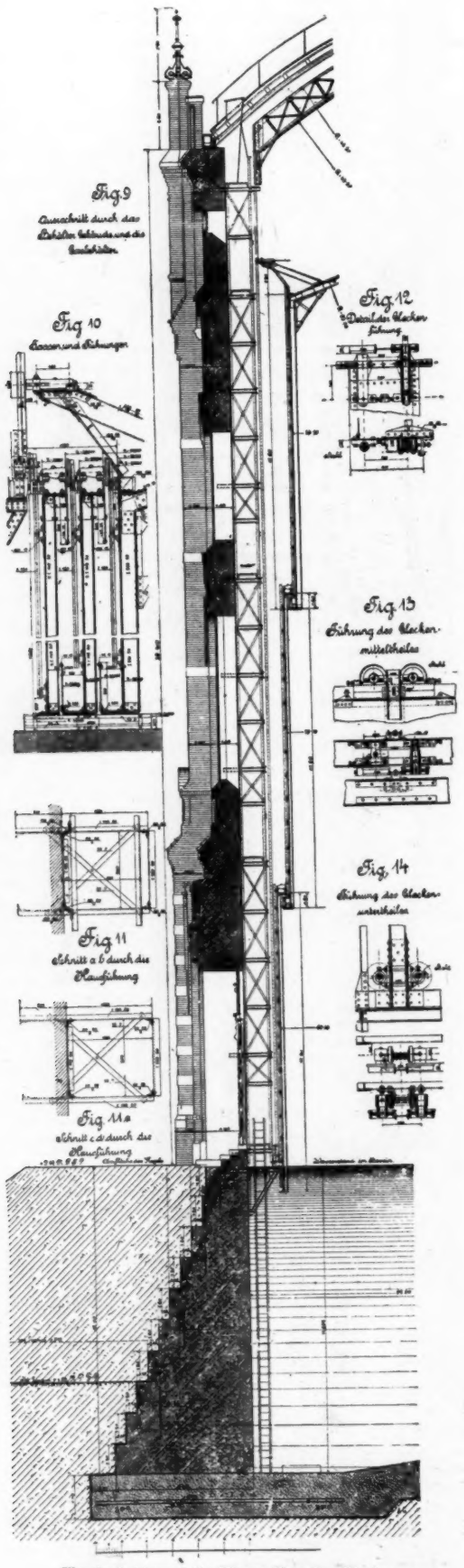
1. *Journal of Gas Lighting.*



The Gasholders at the Vienna New Gas Works.

ordinary bricks and Roman cement mortar; and the brickwork is left uncovered, except where there are sloping surfaces, as on the cornices, doorways and columns. These surfaces are covered with green glazed roofing tiles. On the ground floor, the superstructure is interspersed with bands of plaster, which are also inserted in the upper floor above and below the windows. The topmost floor is rendered attractive by pilasters and semi-cylindrical arches, above which is a massive principal cornice, with an attic railing and finishing columns.

The guide columns for the bell (see Figs. 9 to 25), and the roof supports tally with the 18 columns on the face of the building; and there are 6 galleries inside corresponding with the position of the fully extended 3-lift bell of the gasholder. On the outside, the storeys formed by these galleries are distinguishable by the large windows. Inside the house is an iron staircase, by which the holder may be reached. No provision is made for going up the walls of the houses from outside, except where the two houses of each pair approach nearest to one another, at which point they are joined by a bridge, to which means of access are provided. The walls of the gasholder houses are 5 feet 4 inches thick at the basement or footing, 4 feet 5 inches at the ground floor, 3 feet 5 inches at the first and second stories, and 3 feet at the topmost story. The roof supports are nearly 152 feet above the level of the ground, after it had been raised as already stated. The apex of the lantern of each roof is 221 feet above that level, and consequently more than 226 feet above the level of the land in the vicinity.



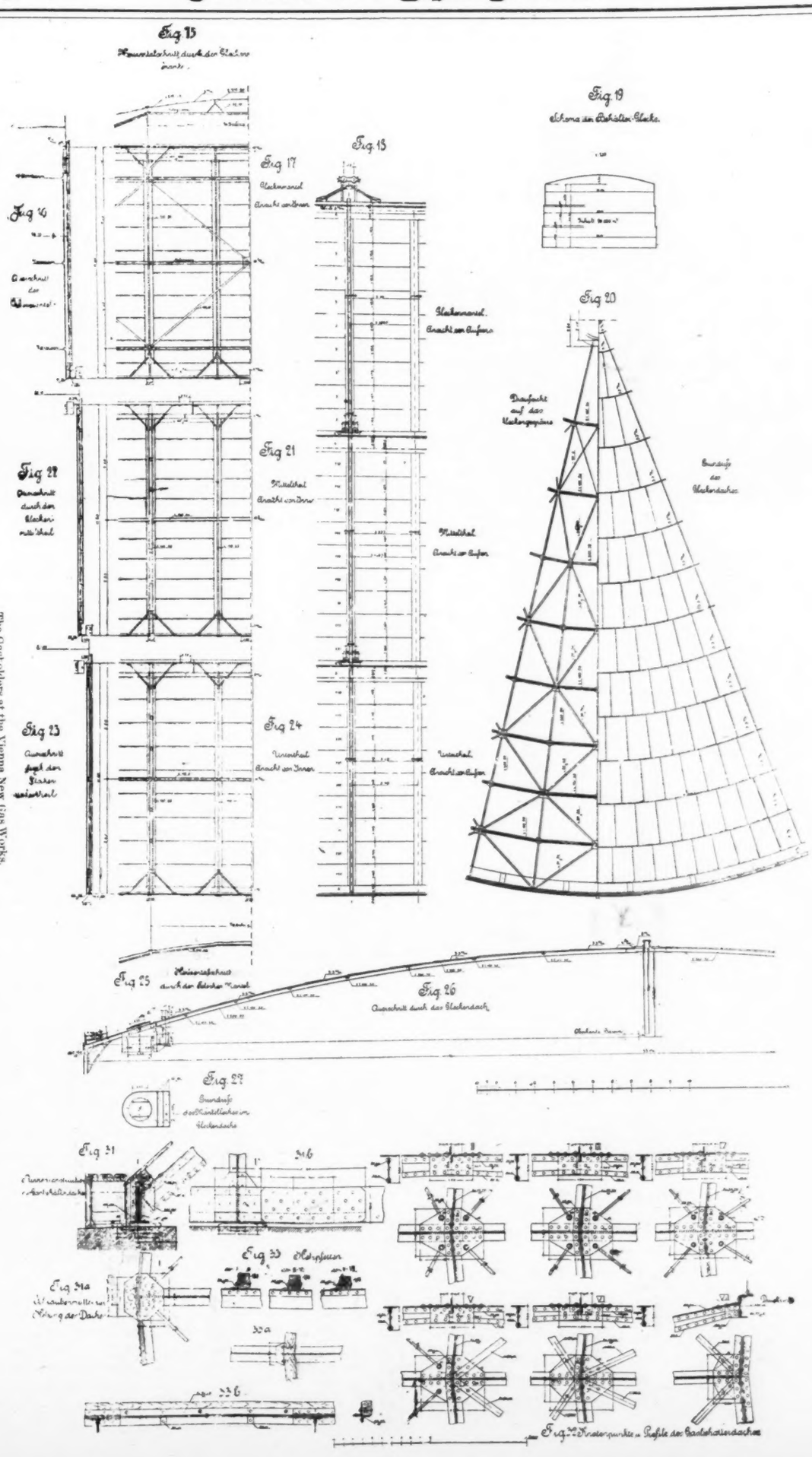
The Gasholders at the Vienna New Gas Works.

The bracket supports for the guides of the gasholder were made by building out the brickwork of the house walls, by which plan an internal bond of masonry was obtained. This method of procedure did not give rise to appreciable error in the erection of the guide rails. The cupola shaped roof of the holder is supported by an iron framing constructed on the Schwedler system (see Figs. 1-36). The cross section of the dome is a segment of a circle, 142 feet 9 inches radius; and the rise amounts to 43 feet 9 inches. A parabolic shape of dome was rejected on æsthetic ground. The roof is constructed of 36 radial girders from 8 to 11 inches deep, and of 7 rings set at distances of 15 feet 11 inches apart. The rings are not made up as regular curves, but as polygons, in order to avoid risks of distortion; and diagonal ties are placed across the girders and rings. The inmost ring, under compression, has a diameter of 42 feet 8 inches; while the diameter of the bottom ring, which is in tension and is formed of flat iron, is 208 feet 8 inches. On top of the pressure ring rests the wall of the lantern, 15 feet 5 inches high, and provided with windows and a dome shaped roof having a height of 8 feet 6 inches. The roof is covered with wood and sheet zinc roofing. The calculations for the roof were based on a maximum load of snow of 15.36 pounds per square foot of horizontal projection, and a maximum wind pressure of 30.72 pounds.

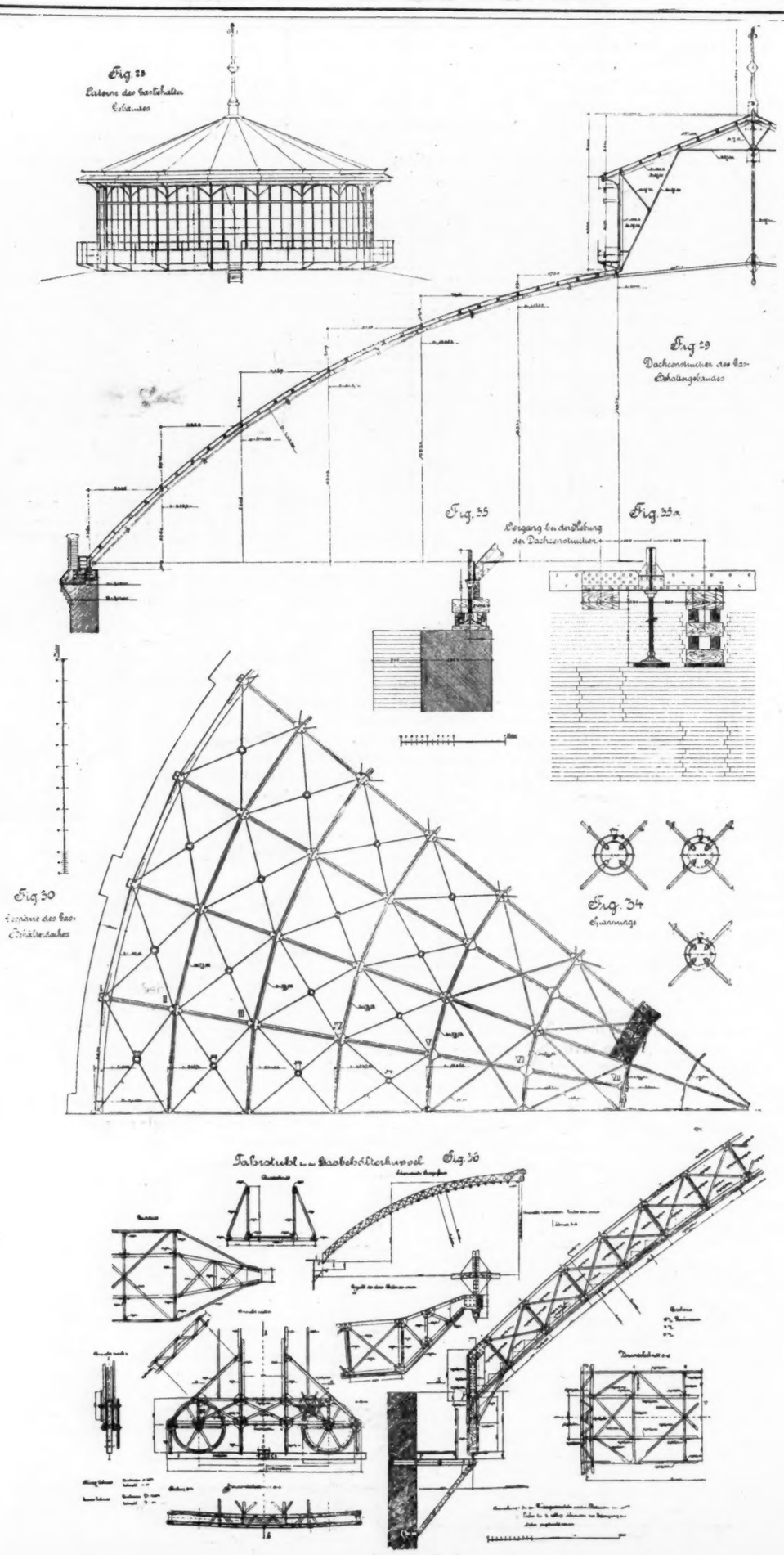
In order to gain access readily to the interior of the roof, a travelling staircase is provided for each gasholder. Its sides have the same radius as the roof girders, and one end of it is carried on a pivot in the middle of the roof; while the other rests on a carriage, which can be moved round on rails on the outside of the topmost gallery (see Fig. 36). Thus any part of the interior of the roof can be at once reached for inspection or repairs. On the exterior, the usual stairs and circular gangways are provided. The roofs were actually put to an unusually severe test during the first year that the holders were at work, for a heavy fall of snow caused it to settle on parts of the roofs to a depth of nearly 20 feet. But no evil effects could be detected.

The tanks of one pair of holders were first finished, and then while the roofs of these were being erected, the tanks of the second pair were made. By this arrangement of the work, two framings for erecting the roofs were saved. The roofs were raised by means of screws while the walls of the gasholder houses were being built. The large dimensions of the holders and the great depth of the tanks rendered very extensive framings necessary for the erection of the roofs. One of these framings is seen in Fig. 1, and in the photographic reproduction. The highest floor of the framing was 73 feet 6 inches above ground level. The framing took from 4 to 6 weeks to erect; while the construction of the roof itself only required, on an average, 29 days. The weight of the roof structure is 143 metric tons. For raising each roof while the walls were being erected, there were employed 36 external screw spindles nearly 4 feet in length. These screwed into the bottom ring of the roof opposite the ends of the rafters (see Figs. 35 and 35a).

Directly above the foot of the screw spindle, and attached to it by cottar pins, was the socket or collar in which the levers for raising the roof were inserted. On each side of each screw, and 39 inches apart, center to center, were attached to the angle iron of the outer ring of the roof two wooden blocks 27½ inches long and 13¾ inches high. The procedure followed in raising the roof was for one of the workmen at a given signal to turn the lever, inserted horizontally in the collar already referred to, through an angle of 90°, and in this manner to lift the roof gradually about 40 inches. One of the blocks attached to the outer ring was then propped up by a number of wooden blocks, and the weight of the roof thns taken off the screw, the foot of which was then raised to a higher position. In the space thus gained, the wall was then built up round the supporting column of wooden blocks; and finally the second wooden block on the outer ring of the roof was provisionally used to support it on the newly erected portion of the wall.



The Gasholders at the Vienna New Gas Works.



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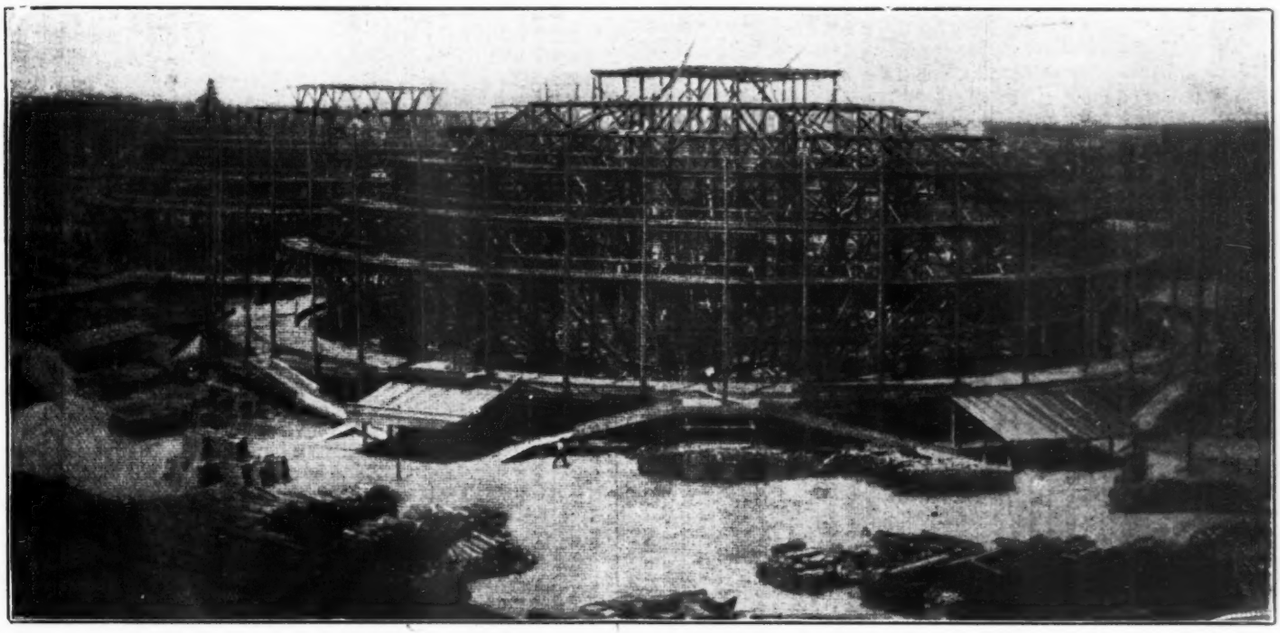

Timber Framing to Support the Gasholder Roof.

The first column of wood could then be removed and the gap left for it in the wall filled up. The screw could then be set up again on the fresh masonry of the wall, and the roof again lifted by about 40 inches.

The work of raising the roofs had, of course, to be most carefully supervised, and constant care taken that they were in their proper positions. No evil results ensued through want of uniformity in the lifting process, as had been feared at the outset. In calculating the dimensions of the outer ring of the roof, regard had, however, been paid to the strain which would be put on it by the raising process. Lightning conductors were fixed at the time the roofs were being erected; and actually during the construction of the holders several discharges were conducted away without doing any injury to the structure.

The way in which the preliminary work had been hastened on enabled the first sod for the holders to be turned on Dec. 28, 1896; and the contract for the iron work of their roofs to be placed on the following day. The four holder houses were to be completed by July 1, 1898; but premiums were offered by the municipality for their completion by an earlier date—amounting to as much as £1,670 for completion by May 15, 1898, and less sums for a fortnight and a month later. Actually the building work on one of the two pairs of holders was finished by May 10, 1898, and that on the other pair by the contract time. The brickwork and masonry of the walls of one pair were actually carried out, including raising the roof, in 84 days, and of the other pair in 72 days. The conditions of weather at the time were favorable to the work; but the great speed with which it was carried out is said to have been in no small degree due to the enthusiasm of all concerned for it. During the busiest week the number of workmen employed each day on the construction of the holders averaged 1,590.

In order to support the tank walls against the considerable pressure of water, the customary embankment round about the tank was made of well-rammed ballast, free from sand, which was obtainable at a reasonable distance from the site. But unfortunately the large quantity of material—viz., 82,500 cubic yards of ballast, and 11,800 cubic yards of mould, necessary to raise the cone to the required height of 26 feet 3 inches, had to be brought to the spot by the tedious method of carting, as, owing to a number of circumstances, it was impossible to utilize mechanical means of transport, or even tramway metals. Concrete was used in the narrow strip between the tanks of two adjacent holders.

The inlet and outlet mains of the gasholders are 48 inches in diameter. Those for each pair enter a special house, in which are the valves, pumps, etc.

Each of the four gasholders has a capacity of 3,178,500 cubic feet; and hence the four provide storage for 12,714,000 cubic feet. On the basis of a maximum daily make of 15½ millions, for which the present plant of the works is designed, the storage would amount to 83.3 per cent. of the maximum daily make. Even with the extension of the plant for a maximum output of 17½ million cubic feet, the holders would still be equal to storing 72 per cent. of the maximum make per diem.

The original scheme of Herr Hermann comprised the construction of trussed crowns to the gasholders. The central king post of the trussed roof was to rest on a pier of masonry when the holder was in its lowest position. But the great object which characterized the erection of the Vienna gas works—viz., the saving of time on the work—precluded the constructing engineers spending time on studying a special scheme of gasholder construction; and, therefore, the firms tendering for the work were left with a free hand to offer their own designs. Ultimately, the tender of a Vienna firm (Messrs. Gridl) for the four gasholders was accepted; but no fewer than five firms were employed by them on the work under sub-contracts.

Their scheme embodied the use of a self-supporting crown, without any extraneous support for the ribs when the bell was in its lowest position. The chief proportions of the holders are shown diagramatically in Figs. 1-36. Each is in three lifts. The inner lift, or bell proper, has a diameter of 190 feet 10 inches; while the second and outer lifts are 193 feet 11 inches and 196 feet 10 inches in diameter respectively. The crown of the bell is of spherical section, with a radius of 305 feet, and a rise of 15 feet 1 inch. Each lift is 38 feet ½ inch in height; so that the holder, when fully extended, has a height of 110 feet 3 inches. It was stipulated that the fully extended holder should throw a pressure of 8.3 inches of water; the inner and second lifts 6.7 inches; and the inner lift alone 4.9 inches. The calculations were based on a maximum pressure of 8.4 inches of water, which is equivalent to a total pressure of 578 metric tons on the roof of the bell, or of 43.6 pounds per square foot of its surface.

The crown of the bell is constructed of girders similar to the roofs of the gasholder houses. The angle ring, or curb, where the crown meets the side sheets, is attached to 54 girders or ribs, which are divided into 9 sections by 8 intermediate rings. The rib girders are made throughout of rolled I-joists, 7.9 inches deep. A stiff triangular bonding is obtained by means of diagonals inserted between the ribs and the rings. The skin or sheets lie unfastened on the framing of the crown when the holder is grounded; being attached to it only at the curb and at the center of the dome. Thus the pressure of gas within lifts the skin of the crown independently of its framing. The skin consists of plates 0.13 inch thick, except that the outer row attached to the curb are ¼ inch thick, and that at the apex of the crown plates from ⅛ to ¼ inch thick are used.

All the rings of the roof framing except the sixth consist of two rows of U-iron, 3.9 inches deep, riveted to one another. The sixth ring, at which each alternate rib terminates, is stronger. It consists of two rows of U-iron, 11½ inches deep and 3 inches wide, riveted together. The diagonals are of angle iron, except in the topmost ring, where they are of flat iron. The different parts of the roof framing are joined at the places where they cross by means of wing plates. There are three manholes on the crown. Two are over the inlet and outlet mains, and are of the well-known type which admits of these mains being reached for

cleaning purposes without the holder being completely emptied of gas.

The angle ring or curb consists of a vertical plate, 21½ inches deep and ½ inch (full) thick, to which are attached two angle irons, 6.3 inches by 6.3 inches by 0.75 inches, and a plate 26.3 inches wide and ½ inch (full) thick, which is at first horizontal, but is then bent obliquely. Next to this plate comes the ½ inch thick row of plates forming the transition row to the ordinary 0.13 inch plates of the crown.

The rafters of the roof, the framing of the sides of the bell, and the curb are also fastened to one another by strong fishplates and brackets, so that these parts of the structure can securely carry the weight of the two lower lifts and cups, which depends on them and amounts to 300 metric tons. The sides of the inner lift or bell consist of a framing of 54 double T uprights, 7.9 inches deep. These uprights are stiffened and supported by two horizontal polygons of iron. The guides for the bell are put on its outside opposite 18 of the angles of the polygon, so that the pressures which arise in guiding the bell are transmitted directly to the framing of the bell. Flat diagonals connect the horizontal and vertical members of the framing of the sides of the bell. The bottom of this framing is formed on the inside of angle iron, and on the outside by the ring-shaped cup, which is similar in construction to the cups and dips of the other lifts. The top and bottom rows of plates are ½ inch thick; the intermediate ones ¼ inch thick. All the cups and dips of the holder are 23½ inches deep, and consist of U-iron, 10½ inches wide, placed horizontally, to which vertical plates, 23½ inches high and ½ inch thick, are attached. Their edges are stiffened by flat iron riveted to them. The quantity of water required to fill each cup is 5,280 gallons.

The framing of the middle and outer lifts consists of 18 principal and 36 intermediate vertical stays, which are stiffened at half their height by being tied together by a polygon of U-iron, 5½ inches deep. The 18 principal vertical stays, which correspond with the 18 guides, are formed of two lengths of U-iron, 5½ inches deep, which are riveted at a distance of 5½ inches from one another, and fastened to the side sheets by means of a plate 17½ inches wide and ½ inch thick. The intermediate stays are formed of 5½ inch deep double T-girders. The side sheets are $\frac{1}{16}$ inch thick, except the top and bottom rows of each lift, which are ¼ inch thick. Two manholes, with lids to unscrew, are provided in the sides of each lift, a little above its bottom. The joints are made tight with an insertion of jute saturated with red lead. The weights of the structure of the middle and outer lifts are 113 and 116 metric tons respectively.

The bell and lower lifts are guided on 18 vertical rails, by tangential rollers only. The 18 guide columns of each gasholder house are constructed as lattice standard (see Figs. 1-36), having the angles of angle iron, 3.15 inches by 3.15 inches and $\frac{3}{16}$ inch thick. The guide columns rest on strong brackets, which were built in the walls of the tank during its construction. They are strong enough to support the bell and lower lifts during erection or reconstruction. Besides taking the pressure of the guide rollers, the lattice standards have also to support the 5 galleries, which run round the interior of each house. Secondary supports for these galleries are, however, inserted in the masonry of the walls of the house.

The guide rollers, with the exception of those at the top of the inner lift, are all flanged. The pins of the rollers are of steel. The guides consist throughout of planed double T-iron, 7 inches deep, riveted to the framing of the bell or lower lifts opposite the principal stays of the sides of the holder.

Ten months were allowed for the erection of one of the holders. Actually, the bell and guides of Nos. 1 and 2 holders were commenced on August 2, 1898, and finished on the 16th and 2d of April, 1899, respectively; while those of Nos. 3 and 4 were commenced on June 29, 1898, and were finished on February 12 and January 29, 1899, respectively. The weight of one holder is about 600 metric tons; while the house guides, galleries, staircases, and railings make up a further 175½ metric tons. The weight of the iron used in the holder, guides, galleries, staircases, and railings amounts to 5.37 pounds per 1,000 cubic feet of holder capacity, of which 4.18 pounds is for the holder alone. The cost of the iron structure works out at 1s. 5½d. per 1,000 cubic feet capacity, of which the cost of the holder proper amounts to 1s. 1½d.

Directly the smooth concrete bottom was finished, it was covered with a layer of sand 6 inches deep as a protection, and the scaffolding for the construction of the bell of the holder was set up. This is shown in Fig. 2. After the erection of a holder had been finished, the work of drawing out the sand and of repairing the cracks, which had appeared as three concentric circles in the bottom of the tank of all 4 holders, could be commenced.

In order to fill up the fine cracks on the bottom of the tank, it was covered with a layer of white lime mortar 0.4-inch thick, and then the filling of the tank with water was begun. For filling the 4 tanks 26,400,000 gallons of water were required; and the greater part of this quantity was pumped from 2 wells, sunk on the gas works land, by means of Worthington pumps. By this plan, a trial was at the same time made of the productive capacity of the wells. A small quantity of water only was taken from the deep water well service. In order to counteract the attacks of the free carbonic acid in the shallow well water on the rendering of the bottom of the tank, and in order to fill up fine cracks in the rendering of the walls, white lime was added at fixed intervals during the filling of the tank. The filling of the tanks occupied 35 days, and the pumping was finished on May 31, 1899. In the intervals, exact observations were made as to the soundness of the tanks. The results were awaited with much interest and some anxiety by the engineers; but they proved to be extremely favorable. As soon as the tanks were filled, the holders were each filled with air and emptied 4 times, in order to test them for soundness and proper working. These trials were finished on July 17, 1899, when all the holders were ready for use.

[To be Continued.]

Gas Advertising.

[A paper read by Mr. T. M. Ambler, of St. Louis, Mo., at the Fourth Annual Meeting of the Kansas Gas, Water and Electric Light Association.]

The time and thought of most gas managers have in the past been devoted principally to the practice of economies in the manufacture and distribution of their product; but having reached the limit in that direction, it now becomes necessary to devote more attention to its disposition. Therefore, I crave your attention for a short time on the subject of "Gas Advertising," which is now paramount, and trust I may elicit your criticism later, as true criticism should incite redoubled efforts.

The chief aim of a gas advertising genius is to disseminate gaseous information in such an interesting manner as to not only catch the eye and mind for the moment, but to leave the thought so indelibly fixed that it will recur whenever the subject is introduced. This is not an easy task, because our patrons are composed of such an heterogeneous class. A successful gas advertisement must be simple enough for any comprehension, sufficiently attractive to please the most critical, and interspersed with a touch of human nature to appeal to all. I am a firm believer in short, epigrammatic sentences, and in illustration trust you will permit me to quote the following examples, which have been used successfully in my city and with very little variation for the past 5 years:

"Why buy coal, with gas so cheap?"

"Do you carry coal for your health, for the fun of it, or from force of habit?"

"Gas is for the masses—saves time—saves money—saves work."

"Good gas stoves for everybody—cheap enough for anybody."

"Gas is no longer a luxury, but a necessity."

"Use gas everywhere—be happy anywhere."

These constantly reiterated, are unconsciously recalled whenever the subject of gas arises, and in time are accepted as facts. Constant dripping will wear away the largest stone. Constant reiteration is good when care is exercised to vary the manner of presentation so as to escape resemblance to our friend the "parrot" with whose monotonous cry of "Polly wants a cracker" we are all familiar. Too much care or thought cannot be devoted to the preparation of advertising matter; hours of seemingly fruitless work will often bring good results at the last minute.

The plainest statement of facts can be made much more effective if presented in attractive language. A few years ago our local company determined to reduce the price of gas when used for fuel purposes and much difficulty was experienced in composing a suitable announcement of the fact. After many notices had been prepared, none of which seemed effective, it was suggested that we prepare a formal statement of the fact of the reduction, to be used as a display advertisement, and then request the papers to treat it editorially.

This suggestion was acceded to, and the following appeared among the editorial leaders the next morning:

"Dollar gas has been the dream of many of our people, and now we have it, when used in gas stoves and heaters, which are very useful inventions no matter what the price of gas. Gas is one of the things in which increased consumption surely follows reduction in price, and the gas company will not lose a cent on their latest move." This told the whole story concisely, clearly and so as to impress the reduction on the

mind of the reader, and while not intended as an advertisement the appropriateness of the expression made it one of the best and most effective we have ever used. Had no particular time been devoted to the composition af the initial announcement this result would not have been secured.

Much additional value can be given to these short sentences if accompanied by appropriate illustrations. These illustrations should be calculated to arrest the attention and in addition start a train of thought leading to the proper appreciation of the benefits to be derived from the constant and unceasing use of gas. They need not necessarily be confined in their scope, because gas can be utilized in all stages of life, beginning from the time it is burned under an incubator in order to sustain life in the puny infant reposing therein, to that when used in preparing the hot water needed to restore circulation to the chilling extremities of the octogenarian.

We might elaborate and utilize the growth of this infant in illustration of the blessings bestowed by gas during the life of man. Following the time of his departure from the incubator, we may commence when first his attention is aroused by the attractiveness of gas, as seen in the modern gas radiator, especially when enhanced by the beauty and brilliancy of the priceless gems so lavishly bestowed thereon; or we might show him enjoying his first independent splash in water falling from an instantaneous gas water heater; or while basking in the rays of an incandescent gas light, indulging in his initial experience at building castles in the air with blocks. Then he might be seen scratching a match on the seat of his knickerbockers to light the gas, in celebration of his emancipation from the thralldom of skirts. Again perchance, having attained an age to become fully imbued with his own individuality, we might illustrate him using a self-heating gas sad iron endeavoring to secure the indispensable crease in his trousers, without which it would be utterly impossible to maintain his required dignity.

Again we may picture him standing in the shadows of a street gas lamp bidding a lingering farewell to one whose waving hair suggests the frequent use of the gas curling iron, and then a little later might be shown that scene, familiar to all, of a young couple standing beneath the marriage bell pledging each other to use their gas in future from the same meter, and to share the joys and divide the sorrows of the monthly gas bills "Until death us do part."

Such illustrations might be continued indefinitely, but these seem sufficient. However, in conclusion, permit me to say that this entire matter is based on the supposition that gas companies are conducted on a broad and liberal basis. That they occupy well lighted, well ventilated, commodious and well kept offices, in which are attractively displayed samples of the various devices in which gas can be practically used. That their management is progressive, ambitious and quick to see the value of and make needed improvements. That they realize the public have rights which it becomes their pleasure to observe. That all complaints are given reasonable and prompt attention. That all inspectors are not only taught to do their work properly and to jealously guard the interests of their employers but are also instructed to exercise both tact and diplomacy in their intercourse with the public. That all meters are periodically and regularly inspected, so that though it may be possible for them to register incorrectly, it will become highly improbable. That they realize the gas business, like all others, is dependent for success upon the continued good-will of its patrons, and make every effort consistent with sound business principles to retain it. That they are so punctilious in observance of all these matters as well as the appearance of their offices, their works and their employees as to become a source of pride to their patrons, their citizens and their town.

Working Loads for Manila Rope.

[From a paper read by Mr. C. W. Hunt at the last meeting of the Society of Mechanical Engineers.]

The technical reference books in use by engineers do not contain definite information in relation to the proper working loads for manila rope when used in tackle blocks or for cargo hoisting. The hoisting of heavy weights is an important branch of erecting work, and I desire to record in the proceedings of the society a statement of the result of an extended experience, together with some examples of the life of rope in actual service, which will be a guide to engineers in judging what service can reasonably be expected in similar cases.

The ultimate strength given in Table II. is materially affected by the age and condition of a rope in active service, and also it is said to be the fact that rope is weaker when it is wet. Trautwine states that a few months of exposed work weakens rope 20 to 50 per cent. The ultimate strength of a new rope given in column B is the result of tests made by the company with whom I am connected of full sized specimens of manila rope, purchased in the open market, and made by three independent rope walks. The results were given in a paper printed in the "Transactions" of this society. Prof. B. Kirsch, of the Imperial Royal Technological Industrial Museum, in Vienna, has since broken over 200 specimens of rope, mostly 35 mm. (1⅜ inches) and 55 mm. (2⅛ inches) diameter, and his results agree within 5 per cent. with these figures. Professor Kirsch demonstrated that within the limits of commercial sizes of hoisting rope the full strength could be obtained for larger as well as for smaller sizes. When the strength falls off the rope is imperfectly laid, or made on a machine too weak for the work. The ultimate strength of rope is, in this class of work, useful for one purpose only—that is, to estimate the factor of safety with any given stress. The strength given is for ordinary commercial rope, which may be greatly exceeded in strength by rope made of selected materials. The table can be depended upon as a reliable and safe guide in estimating the factor of safety for any case in hand.

Diameter of Sheaves.—The proper diameter of pulley block sheaves for different classes of work, given in columns F, G and H (Table II.), is a compromise of the various factors affecting the case. An increase in the diameter of sheave will materially increase the life of a rope. The advantage, however, is gained by increased difficulty of installation, a clumsiness in handling and an increase in first cost. It can safely be assumed that the best size is one that balances the advantages and the drawbacks as they are found in practical use and makes a fair balance between the conflicting elements of the problem.

An abundance of data is available from which to draw a reasonable conclusion in the premises. A few typical illustrations will make clear the method of procedure, and also be of service in showing what changes in sizes or proportions an engineer, in any given case, could make to reach a higher efficiency of mechanism or a greater commercial economy.

In driving 28,908 piles on the Chicago, Milwaukee and St. Paul Railway the engineering department kept an accurate account of the number of piles driven by each one of the 79 lines of various sizes of manila rope used. From this record the average number of piles driven by each size of rope was computed, and also the cost of rope per pile driven was ascertained. This account showed that for hammers weighing from 1,800 to 2,600 pounds 1¼-inch diameter rope was the best, and for hammers from 2,600 to 3,200 pounds rope 1⅜ inches in diameter should be used. Similar records covering many years have been kept by various coal dealers of the diameter and cost of their rope per ton of coal hoisted from vessels, using sheaves of from 12 to 16 inches in diameter. These records show conclusively that in hoisting a bucket that produces 900 pounds stress upon the rope a 1¼-inch diameter rope is too small and a 1⅜-inch rope is too large for economy. The size in general use for this work is 1⅓ inches. The Pennsylvania Railroad Company uses 1¼-inch rope, running over 14-inch diameter sheaves, for hoisting freight on all their lighters in New York harbor, and handle on a single part of the rope loads up to 3,000 pounds as a maximum. Greater weights are handled on a 6-part tackle.

Robert Grimshaw, in 1893, in collaboration with Lieut. J. A. Bell, of the Equipment Bureau, U.S.N., made a series of tests at the Brooklyn Navy Yard on sheaves of various diameters and with various loads. The rope was ordinary manila, three strands, 3¾ inches in circumference, such as is used in the United States Navy. It was dry and tested on a "cat and fish" tackle constituting a 6-fold purchase; sheaves 8 inches in diameter, the three upper ones having roller bearings and the three lower ones plain solid bushings. The lower block and hook weighed 75 pounds.

Life of a Rope.—It is interesting to compare the life of a rope when used with the stresses and sheaves given in columns C and F (Table II.) and one used with those of columns D and G. To illustrate this, take two cases using exactly the same size and quality of rope, one to be worn out in hoisting coal from vessels, with stresses and sheaves as per columns D and G, and the other to be used on a rope drive, with the stresses and sheaves as per columns C and F; all the wear on the ropes comes from its internal friction in bending over the sheaves and its external chafing in running on and off them. A record of the number of bends made by each of the ropes will be a convenient means of comparison. A rope 1¼ inches in diameter usually hoists from a vessel from 7,000 to 10,000 tons of coal on a well arranged hoist. The rope will have a working stress of from 850 to 900 pounds running over 3 sheaves, one 12 inches and two 16 inches in diameter; in hoisting 10,000 tons it makes 20,000 trips, bending in that time from a straight line to the curve of the sheave, or *vice versa*, 120,000 times. The rope

when this service is completed, is worn out and must be replaced by a new one.

To illustrate the endurance of the rope used in the transmission of power, take a tin plate mill transmitting 1,000-horse power to the rolls by means of 1¼-inch diameter manila ropes. In one particular case the sheaves are 5 feet and 17 feet in diameter and 36 feet apart, center to center. The rope is 86 feet long, runs 5,000 feet per minute, making 13,900 bends per hour, or more bends in 9 hours' service than the other rope made in its entire life. As is well known, the life of a transmission rope is measured by years, not hours. This enormous difference in the life of ropes of the same size and quality is wholly gained by reducing the stresses on the rope and increasing the diameter of the sheaves.

Weakening Effects.—The weakening effect given in the table of various knots, hitches and bends used in rope tackle is based upon experiments made in the laboratory of the Massachusetts Institute of Technology. Forty-five pieces of 2¼-inch circumference, 3-strand manila rope, cut from one coil, were broken in sets of from 3 to 7 ropes, each rope of a set having the same fastening, and an average of each set computed. Each different set tested some one of the fastenings in common use. The results were not erratic, but consistent, and from them a safe conclusion can be drawn. In examining the various knots broken it is evident that those fastenings in which the standing part makes a short bend over another part of the rope are the weakest. Those like a round turn and a half hitch, or a timber hitch, have a less abrupt bend in the standing part, and are materially stronger. With care an eye in the end of a rope having the ends of the strands tapered down can be spliced over an iron thimble so that it will have substantially the full strength of the rope, but as it is usually made it is not so strong, for which due allowance is made in the table. The same remarks apply to a splice in a rope. In the table some knots are included that were not tested, but whose approximate strength is evident from their formation. The table is only a guide to be used in estimating the factor of safety. The loss of efficiency by the use of these knots was conclusively settled by the experiments above mentioned and the numerical value fixed within such narrow limits that the results cannot safely be ignored in executive work.

It will be understood that a table of working loads must be a general one, covering ordinary cases arising in practice. Local conditions may be such as to make it advisable to vary from the stresses given in the tables. In cases of great importance an engineer should carefully investigate the subject in detail and then decide upon the exact stresses that he will put on his tackle; but ordinary cases are fully covered by the data given in the table herewith.

TABLE I.—*From Grimshaw Report.*

Net Dead on Tackle. Weight Raised. Pounds.	Theoretical Amount Required to Raise the Net Weight. Pounds.	Actual Power Required. Pounds.	Extra Power Required Over the Theoretical	
			Pounds.	Per Cent.
600	100	158	58	58
800	133.3	198	64.3	48
1,000	166.7	243	76	45.8
1,200	200	288	88	44

TABLE II.—*Working Load for Manila Rope.*

A. Diameter of Rope.	B. Ultimate Strength.	C. Working Load in Pounds.			D. Minimum Diameter of Sheaves in Inches.		
		Rapid.	Medium.	Slow.	Rapid.	Medium.	Slow.
1	7,100	200	400	1,000	40	12	8
1¼	9,000	250	500	1,250	45	13	9
1½	10,000	300	600	1,500	50	14	10
1⅝	13,400	380	750	1,900	55	15	11
1¾	15,800	450	900	2,200	60	16	12
1⅞	18,800	530	1,100	2,600	65	17	13
1¼	21,800	620	1,250	3,000	70	18	14

TABLE III.—*The Efficiency of Knots in a Percentage of the Full Strength of the Rope, and the Factor of Safety when Used with Stresses as per Column E, Table II.*

I.	J. Eye Splice Over an Iron Thimble.	K. Short Splice in the Rope.	L. Timber Hitch, Round Turn, and Half Hitch.	M. Bowline Slip Knot, Clove Hitch.	N. Square Knot, Weavers' Knot, Sheet Bend.	O. Flemish Loop, Overhead Knot.	P. Rope Dry. Average of Four Tests from the same Coil as the Knots.
The efficiency of the knot.....	90	80	65	60	50	45	100
Factor of safety...	6.3	5.6	4.5	4.2	3.5	3.1	7

In this table the work required of the rope is, for convenience, divided into 3 classes—"rapid," "medium" and "slow," these terms being used in the following sense:

"Slow"—Derrick, crane and quarry work; speed from 50 to 100 feet per minute.

"Medium"—Wharf and cargo, hoisting 150 to 300 feet per minute.

"Rapid"—400 to 800 feet per minute.

The diameter of the rope in column A is obtained by dividing the girth by 3.1416. This method gives for a 3-strand rope nine-tenths and for a 4-strand ninety-three hundredths of the diameter of a circumscribed circle. The girth method corresponds closely to the circular diameter of the rope when under stress and is the most convenient method to use.

The Physical Principles of Illumination, with Special Reference to Recent Methods.

[A paper presented to the Department of Physics, of the Brooklyn Institute of Arts and Sciences, December 19, 1901, by MR. DOUGLASS BURNETT.]

The frequent reports of improvement in methods of lighting make it desirable to review the basic scientific principles applied in the art in order to correlate existing methods and look into the possibilities of future development. While we are still far from understanding the chemical and physical reactions in even ordinary flames, yet fundamental principles seem simple; but this may be due to superficial study and failure to apply more than general terms. Thus, incandescence is used as describing any property of emitting light, except fluorescence and phosphorescence, included in the more general term luminescence. The very beautiful and recondite effects studied under these latter heads have probably led scientists to ignore the simpler and more practical proplems of incandescence which we are to study this evening, with the result that scientific research is seldom directed toward a solution of the physical problems which worry the lighting engineer who is getting to be a specialist. For our purposes, we may dismiss these purely scientific phenomena by definitions. Fluorescence is a property possessed by certain liquids such as some oils and by a few solids, such as fluorspar and quinine sulphate, of emitting light of a characteristic color when exposed to white light; and phosphorescence is a property possessed by some solids of emitting light of feeble intensity *after* exposure for a sufficient time; it is also applied to certain insects, and is then called the photogenic property. There is no name I know of applied to gases, which are never incandescent in the ordinary sense, though they emit light at the temperature of flame and when under excitation by an electric current. Luminescence involves only physical phenomena, while incandescence involves both chemical and physical, and from that standpoint is doubly interesting.

Further, incandescence involves the production of heat as well as light; and in fact the light is usually produced by the heating of a body or a set of particles to a temperature of over 525° C.

As we are chiefly concerned this evening with physical questions, we will first dispose of the chemical ones. An ordinary flame is caused by the oxidation or burning of the carbon compounds, solid in the case of a candle and liquid in the case of an oil lamp, distilled into vapor by the heat, and gaseous in the case of illuminating gas. It seems fairly certain that acetylene is formed, which splits up, the hydrogen burning into water and furnishing the heat to render white-hot the carbon which is precipitated, which then burns into carbon dioxide. When air is introduced into a gas flame in sufficient quantity, carbon monoxide is formed, burning with a blue or green light, the luminosity failing to appear.

It is thus evident that the hottest part of a flame is its surface in contact with the atmosphere, while the interior is cooler but hotter than the lowest point of visibility, stated at 525° C. It is also readily seen that there are losses of heat constantly going on, partly by radiation, partly by conduction through the metal of a burner, but chiefly by convection of the currents of air which furnish the life of the flame. Hence it is apparent that a small flame, such as that of a candle, is on the average colder than a larger one, or one provided with more oxygen.

The spectrum of an incandescent body is always continuous, like sunlight, and the relative brightness of the various colors increases from the red end to the violet end of the spectrum as the temperature increases, the red preponderating at low temperatures and the violet at high, and it may be accepted as generally true that the whiter the light the higher is its temperature. On the contrary, the spectrum of light from luminescent bodies is usually split up into lines or bands.

A method of comparing the temperatures, and hence the efficiencies of various sources of light, is by means of their "intrinsic brilliancy," defining the amount of light emitted from a unit surface. For instance, we have the following figures showing the candle power per square centimeter: Argand gas burner, at 1,800° C., 0.3; Siemens regenerative burner (one of the brightest gas lamps), 0.38 to 0.6; electric incandescent lamp, 40; Nernst electric lamp, 100; crater of an open arc lamp, at 3,500° C., 6,400. For ordinary cases we may say that a square inch of gas flame emits 4-candle power, whereas for the crater of an arc lamp the pro rata figure is 42,600-candle power.

In photometry the unit area of a luminous body produced in a certain manner, and hence at a certain temperature and of fixed color, is sometimes used as a standard for comparing the strength of artificial lights. One apparatus is the "Methven screen," consisting of a blackened metal plate with a square or rectangular opening of a predetermined size in front of a certain part of the flame of a standard burner, usually a London Argand. Similarly, the Violle standard is the amount of light which may pass through an opening of one square centimeter placed in front of platinum at its melting temperature of 1,775° C.

We have seen that, as means for increasing the temperature are provided, a light becomes brighter; that is, the percentage of light energy to total light and heat energy increases. This ratio is called the "optical efficiency," and is as follows in some instances: Argand oil lamp, 2½ per cent.; naked gas flame, 5 per cent.; electric incandescent lamp, 6½ per cent. at 3 watts per candle; Nernst electric lamp, 13 per cent. at 1 watt per candle; burning magnesium, 15 per cent.; 5,000-candle power arc lamp, 25 per cent.; sunlight, 25 per cent.; the light of Geissler tubes, 33 per cent.

One of the methods of increasing the temperature is to construct the lamp to avoid waste of heat. The greater efficiency of the incandescent electric lamp as compared with gas flames is partly due to the absence of loss from convection, as the filament is in a vacuum, and to the small loss of heat by radiation and by conduction through the leading-in wires. Another reason is that the amount of electric current energy adjusts itself automatically to the dimensions of the filament, while in a gas flame there is no method of adjusting the quantity of the carbon particles so as to use up all the heat energy supplied. The high efficiency of the arc lamp results from the use of the electric current over a very limited surface called the crater, and for the purpose of vaporizing the carbon, the temperature of vaporization being very much higher than that of combustion. The effect is enhanced in the so-called inclosed arc lamp, in which a small globe surrounds the arc, and, having but a small connection with the outside air, maintains a heated atmosphere of carbon dioxide about the arc proper, resulting not only in a diminished waste of the carbons and consequently less attendance, but also in a longer arc and better distribution of the light.

Under some circumstances colored lights are attractive, and many consider that the most beautiful part of the illumination at the Buffalo Exposition was the delicate red color of the light when first appearing. But the eye is accustomed to daylight, and as all artificial lights are weak in comparison the most attractive artificial light is the whitest.

Having granted the previous considerations, we are in position to assert that the object in artificial lighting must be: First, to increase the temperature of the light source in order to increase the whiteness and purity of the light; second, to decrease the heat losses in order to increase the efficiency; third, adjust the quantity of the luminous substance to absorb the greatest amount of heat at the highest temperature; fourth, select a substance to be rendered incandescent, having maximum emissivity; and fifth, extend the luminous substance in such manner as to give the greatest amount of diffusion to the light.

The method of increasing the temperature most generally used has been the admixture of air with the gas before burning, and in definite proportions, as first pointed out by Davy and by Bunsen. By the use of pure acetylene the quantity of solid material deposited in a flame is increased and consequently its light giving qualities, though acetylene does not enrich illuminating gas. Carbon is normally black, and is, therefore, somewhat inefficient as a light giving source; the quantity in an ordinary 5-foot flame at any one time is minute, but measurable, and is estimated at one-tenth milligram, equivalent to 0.0015 grain. Attention to the requirements and available methods has enabled an improvement in the duty of gas, measured by the gas engineers as the number of candle power per cubic feet, as follows:

Naked gas flame, 3; London standard Argand burner, 3.2; Clamond burner, consisting of a basket of platinum wire over a Bunsen flame, 4.26; Siemens' regenerative burner, 4.77; result of a comprehensive test of Welsbach burners, 5.5 to 33; Sugg's incandescent pressure burner, 22 to 32; claimed for the Kern burner, 25; pure acetylene, 84.

The liberation of heat resulting in the structure or phenomenon of flame is the usual result of a chemical combination, and while we are most accustomed to flames which appear in air, it is quite possible they may be set up in other than ordinary atmosphere. Many of the elements form compounds, such as chlorides, when burned in chlorine, which form oxides when burned in ordinary air.

In the burning of magnesium, the intense brightness results not only from the whiteness of the metallic oxide formed, but also from the great quantity of that oxide contained in a flame of unit volume as compared with a corresponding flame in which carbon particles are rendered incandescent. This is shown by its dense smoke, consisting of pure magnesium oxide, which oxide is solid while that of carbon is a gas. The flame temperature is 1,400° C., or about 400° C. less than that of an ordinary gas flame.

This reference to the use of solid magnesium oxide as the illuminating agent brings us to the principle underlying recent methods of lighting, of which the Welsbach system is typical. Many years ago it was noticed that, when the intensely hot flame produced by the burning of oxygen and hydrogen in the proportion required to form water, was allowed to impinge upon a mass of lime, which is calcium oxide, an extremely brilliant light was the result, commonly known to us as the calcium light. It is only recently that the efficiency has been improved by reducing the mass of the substance against a portion of which the flame was allowed to impinge, from a weight of several ounces to a fine fabric or network of material weighing but a few grains suspended over the flame, and covering its surface at the point of combustion and consequently of highest temperature. The efficiency of the oxy-hydrogen lamp was formerly ascribed only to the great temperature of the oxy-hydrogen flame, which flame is the highest in temperature of any that is known; but it is now found that some additional reason for the great luminosity must be assigned, and this is found in the catalytic property of certain of the rare earths.

For purposes of comparison we may assume that a Welsbach mantle consists of a lace-work of collodion, upon which there has been deposited, by dipping into a solution, the oxides of thorium and cerium in the proportion of 99 per cent. to 1 per cent., and that the collodion has been burned away by the simple application of heat, leaving a network of the oxides of the two rare metals stated. If heat be applied to a similar mantle of either of the two oxides alone, the light given out will be faint in comparison with that given by the combined mantle in the proportions stated. It has also been found that, if the oxides in the required proportions referred to are heated to an equal extent in a vacuum, as, for instance, under the intense heat of electric cathode rays, only a small amount of light will be emitted. It is, therefore, evident that oxygen is necessary to the maintenance of the lighting of such a mantle, and it is also evident that the oxides must be in about the proportion stated. Other substances with similar illuminating power are the oxides of chromium and aluminum, and the "Sunlight" mantle, much used abroad in competitition with the Welsbach mantle, consists of these substances. The explanation of the intense light of the Welsbach burner is found in the fact that probably many millions of times a second there occurs "an alternate oxidation and reduction of one of the two oxides, with the corresponding formation and decomposition of the alloy of both oxides," and thus the heat of combination of the unstable oxide, added to the temperature of the flame, produces the higher temperature and increased illuminating power. The temperature of a Welsbach mantle is estimated at from 1,800° C. to 1,915° C., or somewhat in excess of that of a gas flame. Another reason for the increased efficiency of this type of burner is in the much greater quantity of incandescent material available—there are about 4 milligrams of cerium oxide present as compared with 0.1 milligram of carbon in a gas flame, and the result is an increase from 16 to 80-candle power.

A more recent development along similar lines is that of the Nernst electric lamp, although the phenomenon of its lighting power is further complicated by some electrolytic action. The Nernst lamp is in use to a considerable extent in the chief German cities and has recently been introduced into the United States. Some were shown in the Electrical Building at the Pan-American Exposition, and a few were at the recent Street Railway Exhibition at Madison Square Garden. One or two of the larger New York buildings have undertaken some display lighting by this means. A number of American patents have been issued, the most recent including a series in the name of Dr. Nernst, issued within the past few weeks,

Fundamentally the lamp consists of a rod having the color, hardness and mechanical properties of porcelain, and made up of the oxides of some of the rare earths similar to those in use for Welsbach gas mantles. I understand that in this country zirconium is principally

employed, and it is worthy of remark that this metal was early abandoned by the incandescent gas lighting people in favor of more active materials such as we have mentioned. For purposes of distinction, the rod has been called a glower. At ordinary temperatures it is a non-conductor, but after being heated to just above the limit of visibility it becomes conducting, and will become incandescent to a point depending upon its dimensions. But here there arises a further complication in that at these high temperatures the substance of the glower shows an electrolytic action resulting in a black and probably metallic deposit in the vicinity of the negative pole, the deposit extending across the glower and destroying the efficiency of the part affected. My authority for this complication is found in Mr. Wurts' recent paper[1] on "The Development of the Nernst Lamp in America," read before the American Institute of Electrical Engineers. To obviate this difficulty, the lamps have been developed only for alternating current in the United States, when used in connection with which the electrolytic phenomenon is absent, but the lamps are used with direct current in German cities, and the development of direct current lamps here is promised. In practical use the Nernst lamp has also an auxiliary heating device, consisting of platinum wires imbedded in cement and in close proximity to the glower, used to bring it to a sufficient temperature, after which an automatic cutout, consisting of a magnet and its armature, operates to disconnect the heater and to throw the full current into the glower whereupon it flashes into full brilliancy. Close regulation is required and is furnished by means of a "ballast" consisting of an iron wire contained in an exhausted glass globe, its function being to counteract any increase of current in the glower by an increase of its own resistance. The efficiency of the best electric incandescent lamps is commonly expressed as being about 3.1 watts per candle, and of the arc lamp as about 1 watt per candle, the figure in the latter case referring to the mean spherical intensity; that of the Nernst lamp is about 1½ watts per candle, and is, therefore, about twice as great as that of the best electric incandescent lamp, but not as good as the arc lamp.

Both the Welsbach and Nernst lamp developments indicate that we are approaching an era in which lighting may be practically produced not primarily by the combustion of a simple element, such as carbon in a gas such as the oxygen of the ordinary atmosphere, but when the substance producing the light will contain the oxides of elements and perhaps exclusively of the metals of the rare earths.

We are fortunate in possessing an application of Geissler tube lighting, which is the highest in efficiency of all artificial sources of light—I refer to the Cooper-Hewitt vapor lamp. This was shown at a *conversazione* of the American Institute of Electrical Engineers, at Columbia College, early in this year, and the lamps are fully described in a complete set of patents issued this fall. The essential principle is that of passing an electric current at the usual lighting voltage through a conducting vapor of metallic mercury, the pressure and properties of which are such as to bring the conducting power up to a high point. While the efficiency of such a light is no doubt very high, yet the color is so rich in the rays of the mercury spectrum and is so little influenced by the introduction of extraneous substances such as nitrogen, which would furnish the remaining colors making up white light as to produce effects in ordinary application which are startling if not ghastly. The red end of the spectrum is entirely absent and, therefore, when the light falls upon any body containing any of the colors at that end of the spectrum the resulting appearance is black; this is best seen in the lips and skin of a person which appear seriously blackened under this light. It is, therefore, to be feared that the vapor lamp, while very efficient and entirely applicable to existing circuits, has color objections which will render its use impracticable.

You will recall the efforts made by Mr. D. McFarlane Moore two or three years ago, and contemporaneously with Mr. Tesla, in producing vacuum tube lighting applicable commercially, but these do not seem to have reached the practical stage.

We have seen that the electric arc lamp is the most efficient of all artificial sources of light, and that the efficiency of an incandescent lamp is great because of the very small size and weight of the filament and its maintenance in a vacuum, as well as because of the useful application of all the heat furnished by the electric currents. The use of metallic osmium may still further increase this efficiency. Otherwise electric lighting developments are likely to be in the direction of the Nernst lamp, which combines the convenience and good color of existing electric incandescent lamps with the higher efficiency of the arc lamp.

The present tendency of gas engineers is to improve the heat giving quality of gas, now averaging about 600 B. T. U. per foot, if necessary at the expense of its illuminating quality. This results not only from the more extensive use of heating and cooking devices, but also from the fact that gas is getting to be very generally used in connection with Welsbach burners, requiring a flame rendered hot and colorless by the admixture of air. It is fair to state theoretically that in a city gas system using entirely Welsbach lamps, and also furnishing heat or cooking and power, there is no necessity whatever for the illuminating quality of gas.

1. See JOURNAL, Sept. 30, p. 528; Oct. 7, p. 570; Oct. 14, p. 609.

Mr. L. T. Palmer to the Kansas Gas, Water and Electric Light Association.

A feature of the recent meeting of the Kansas Gas, Water and Electric Light Association was a communication from Mr. L. T. Palmer, of Waterloo, Iowa—Mr. Palmer was one of the originators of the Association and is one of its past Presidents—written in acknowledging an invitation to be present at the convention. Mr. Palmer wrote:

Gentlemen and Friends—Through the courtesy of your Secretary I received an invitation to attend your 4th annual meeting at Leavenworth, the honor of which I beg to acknowledge; and it is with deep and sincere regret that I am compelled to be absent from this gathering, it being the first of your gatherings that I have missed.

I note that Secretary Sterrett has found it as hard as his predecessors to get the *active* members to take *active* part in the preparation of papers for your present meeting; so I will unsolicited write you what I might have told you could I have been present to-day—it may not interest you, but it does me very much—viz: "What I have been doing this summer."

Leaving Leavenworth about March 1st, I came to Waterloo, Ia., where a company had been formed, and purchased the old gas and electric plants with the idea of building new and modern plants at once.

First, a short description of our old gas works may not come amiss. Our whole works is covered by one roof 20 feet square. This room contains 2 oil gas benches, hydraulic mains, purifiers, a large work bench and an air pump and engine. There are no condensers, nor scrubbers, nor even a station meter. Just outside is a holder, 30 feet in diameter, and if one looks at its top he will see 500 brickbats cemented to it with white lead, and may know that every brick represents a hole; and for fear that it would collapse I have just put a board roof over it to protect it from the snow and sleet of the coming winter, hoping to keep it in service till we can get a new one erected.

The piping system contained 90,000 feet of main, and 52,000 feet of this was 1-inch pipe; none of the mains had over 2 feet cover in the ground, and a great many of them were laid in furrows, plowed out with a team and plow, about 8 inches deep.

Our electric plant is as good as the majority of old plants, but was sadly overloaded, so that one of my first acts was to put in a larger alternator, and thus far have been able to give very good service.

In June we began laying gas mains for our new system, and have laid over 11 miles this season, the largest being 12 inches, the smallest 3 inches; the latter is wrought iron, the larger sizes being cast iron. Our shallowest pipe has a 3-foot 6-inch cover, and every foot of this has been tested with a pump and found to be absolutely tight before covering; hence we expect our leakage will be at the minimum point.

Our new plant is to be about 1 mile from the old one, which we will simply abandon and scrap when we get into the new. It is situated on the banks of the Cedar river, into which we have the best of sewerage facilities, and from which we shall draw our water direct for our steam plant.

We have a retort house 40 by 60 feet, and have completed 3 benches of 6's, to be clinkered at the rear, where we have 8 feet space, the front having 20 feet to charge in. The coal shed is attached to the house and we unload coal from cars direct.

Our purifying building is 29 by 114 feet, in which we are to have a meter and governor room together. Our machine room will contain an exhauster, a P. & A. tar extractor, multitubular condenser, washer, and 1 scrubber; also two 12 by 16 by 5 purifying boxes, with hydraulic lift for covers, and an elevator for lifting the oxide or lime from basement to boxes.

Our holder is to be one lift, 70 feet, with a concrete tank, which in my opinion is the only kind to build. Our tank is about finished, ready for the steel work. This tells you about what we will have to make gas with.

Our electric plant is 52 by 114 feet and in it we will install 2 General Electric, 3-phase alternating generators, direct connected to Buckeye engines, fed from two Babcock & Wilcox water tube boilers. In the

plant there will be no belts at all. Our pole lines we have erected entirely new, having set over 400 poles and strung over 20 tons of new copper. These are nearly completed, in fact about one-half of them are now in use and we are taking down the old ones.

Our transformer system is of the latest design, connecting four or more together, running 3-wire secondaries, or low voltage wires, in the business centers. We will have a system of switches, operated from the plant, to cut out all but one transformer in each group, after the load cuts off, thus saving all current losses possible.

In fact when completed we can truthfully say we have one of the most perfect gas and electric plants that can be built, as our Company has not spared a dollar in their construction, and your humble servant feels proud of them.

I take great pleasure in giving you all a hearty invitation to visit me and see the finest plant in existence. We hope to have it ready to operate in about 90 days.

Again, I regret I am not with you to-day, but the Kansas Gas, Water and Electric Light Association will always have a warm place in my heart, and I shall watch your progress with much interest, as I feel that you can accomplish great good for yourselves by keeping together and getting into closer communion with each other.

Advantages in Systematic Reading of Current Engineering Literature.

Prof. H. Wade Hibbard, in an address delivered before the Society of Mechanical Engineers, Sibley College of Mechanical Engineering, Cornell University, remarked that amongst the most valuable members of the engineering profession to-day are the moving spirits of the engineering press. Much matter of great value is regularly to be found in the current periodicals of a profession growing so rapidly and in so many directions as is mechanical engineering. Books, monographs upon particular subjects, necessary as they are by gathering within one cover all the required material of years and many places, and by their orderly classification, logical discussion and evolving of principles, are, by very necessity of their production, always and inevitably behind the times. The reason for existence of the engineering press is to collect all recent valuable information—news, if you please—and present it weekly or monthly, less or more digested, to as large a circle of readers as possible. The American papers, representing special branches of tho profession, far surpass in numbers and variety and excellence the like papers of the old world. Their general use proves that they have a most important place. With these may be grouped the published transactions of the many engineering societies and clubs. Unthinkingly or deliberately to neglect forming an acquaintance with so great a source of engineering knowledge is not fitting for the student who has his own future to make in a country where ruts and old fashions are only for the failures.

Habits are excellent balance wheels, generally. Brilliancy being given but to few men, the great majority must hammer out lesson or problem or engineering feat. In fact, genius has been defined as an infinite capacity to take trouble. Regularity of mind, a habit of undivided intensest application, may place the worker far beyond the one who thinks to accomplish by fits and starts. It is well to form the habit of regular perusal of the weekly *Machinist* or *Engineer*.

Skepticism is the normal state of the scientific mind. It is ever looking for something better, not satisfied that the present is perfect. The reading of articles over the names of famous engineers, afterward to find them severely criticized, is good for the confiding student, who perhaps has supposed that all engineers and professors are agreed. It is just as well for him to learn not to believe all that is in print unless there are good reasons presented.

A good engineering paper should be one of the life partners, ready at hand when moments of leisure permit its instruction and enjoyment, better understood and liked as the years roll on, acquaintance or perhaps friendship formed with editor, contributions made, suggestions given and taken, some share had in its mighty influence in the engineering world.

A union of readers will economize time and enable each to cover more ground and gain greater good. A reading club for discussion, in which each member reads one or two papers and reports upon his leading articles to the rest, is an excellent institution. It has frequently been run with success by the younger men gathered from a railway drafting room, test department, and even including some of the more ambitious young men in the shop. Sometimes a deferred and announced discussion, or an occasionally more formally prepared paper, are useful additions and promote deeper thinking. Such a club adds to the advantage of readers coming into contact with the paper, the decided advantage of more open friction between man and man, a defending of one's position, an acquirement of ability to think while talking, a cultivation of logical placing of thought and word, so necessary for the engineer who must present his ideas to others with force.

Years afterwards, when official responsibilities come, this earlier training will bear good fruit. A superintendent's office will take regularly several papers or several copies of one most useful paper. He marks articles in these papers appropriate for the instruction or spurring of particular subordinates, and sends them out. Later he will call for meetings of these heads of divisions or departments in his office, and resulting interchange of opinions on the papers, tempered with experience, will prove of decided advantage to the business, promoting unanimity of feeling between the departments and the introduction of the best methods suited for each and perhaps all. The speaker recalls with much pleasure such meetings on the Lehigh Valley Railroad, and has been told only recently by President Vreeland, of the Metropolitan Street Railway of New York city, of the success attending his marking of such articles and sending them out, not merely to subordinates, but to some thousands of motormen and gripmen.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

ACCORDING to recent advices the Phœnixville Gas and Electric Company, of Phœnixville, Pa., which has succeeded to the properties and rights of the Consolidated Schuylkill Gas Company, the Schuylkill Valley Illuminating Company and the Montgomery and Chester Electric Railway Company, has perfected its executive organization. The officers are: Directors, I. J. Brower, George C. Carson, Jr., D. J. Collins, W. D. Lippincott, F. P. Norris, L. K. Perot, F. H. Shelton, W. P. Snyder and J. W. Thompson; President, L. K. Perot; Vice-President, D. J. Collins; Treasurer and Secretary, Frederick H. Shelton. The Company proposes to extend its gas mains to and through the districts of West End, Mont Clare and Perkiomen.

THE daily papers of Sunday, Dec. 15th, asserted that plans for the combination of all the gas, electric lighting and street railway interests of Omaha, Neb., were likely to become effective in the near future. We doubt very much whether the Omaha Gas Company's proprietors would consent to sink their identity to a consolidation of the sort outlined. Still, prices may secure properties of any and all sorts.

MR. IRA C. COPLEY, ex-President of the Western Gas Association, and the managing man of the Aurora, Joliet and La Grange Gas Companies, in the named respective places of Illinois, may soon represent the Eleventh district of that State in Congress. While there is a bit of doubt as to the problem, the certainty is that Mr. Copley would represent the district well.

THE proprietors of the United Gas, Electric Light and Fuel Company, of Sandy Hill and Fort Edward, N. Y., have filed an announcement that their stock has been increased from $150,000 to $200,000.

AT the annual meeting of the proprietors of the Gilroy (Cal.) Gas Light Company a dividend was declared on the stock and the foltowing officers were elected: Directors, Amos Robinson, F. R. Cheseboro, S. T. Moore, L. A. Whitehurst and M. Casey; President, Amos Robinson; Secretary, L. A. Whitehurst.

THE proprietors of the Paterson and Passaic (N. J.) Gas and Electric Company are proposing several plant improvements, notable in which planning is the construction of a gasholder up to the retaining of 1,000,000 cubic feet. It is likely the vessel will be located in Passaic, the distributing facilities of that district, which holds the rapidly growing suburbs of Nutley, Franklin, Garfield and Clifton, being altogether inadequate to the demands of the residents for gas in "these days of long nights."

THE proprietors of the Adrian (Mich.) Gas Company having determined to get out of the sale of coal on local account, have disposed of their sheds and moving appliances to Messrs. James Stevenson & Son. The Company has sensibly determined that it could not satisfactorily serve two sets of patrons.

THE rate fixed for gas for the ensuing year, by the Trustees of Redlands, Cal., is $2 per 1,000 cubic feet.

MR. WM. R. BEAL, President of the Central Union Gas Company, of this city, has authorized Messrs. Bartlett, Hayward & Co. to install in the Central Union plant settings of inclined retorts similar in many

respects to those now being operated in the works of the Kings County Gas and Illuminating Company, Brooklyn, N. Y. The details of the contract will be given later on.

THE permanent organization of the Lancaster (Pa.) Gas Light and Fuel Company, and of the Edison Electric Illuminating Company, of Lancaster, as a result of the change in ownership of the named properties, has been thus effected: President, William B. Given; Secretary and Treasurer, Oscar Hoffman; General Manager, Frank S. Given; Superintendent, C. E. Titger.

MR. BANKSON TAYLOR, Manager of the New Orleans (La.) Lighting Company, speaking to a reporter of the New Orleans *Times-Democrat* just prior to its issue of the 10th inst., said that the sale of stoves and other appliances for heating and cooking by gas was going on as merrily as if the season were summer. He also declared there was no question that the mark originally set—12,000 gas stoves on the lines by January 1, 1902—would be reached.

THE Northampton (Mass.) Gas Light Company is comfortably installed in its new office quarters, the building and fitting out of which cost Superintendent Crafts and Treasurer Banister—the latter was naturally and properly the one who paid the bills—many an anxious thought. Now that the struggle is over, the aforesaid gentlemen would be glad to show visiting gas men just what sort of thing the Northampton Company has in the shape of office and show room accommodations.

THE proprietors of the Riverside (Cal.) Light and Fuel Company have purchased a plot on Seventh street (165 by 165 feet) whereon they propose to construct a building that will be in every sense up to their business needs.

DURING the severe storm of mid-December the works of the Mauch Chunk (Pa.) Gas Company, which are located on the Lehigh river, at a low point some distance from the town proper, were badly damaged by flooding. The oil storage vessel suffered most, although the house of the engineer came in for a hard store of smashing. The gas supply, however, was not seriously interfered with.

CONTROL in the ownership of the Delaware County Gas Company, of Chester, Pa., has been secured by the Philadelphia Suburban Gas Company, the headquarters of which are in Darby, Pa., and the ownership of which is vested in the syndicate headed by Mr. Frederick H. Shelton. Chester certainly has been and is sure to remain a good gas field.

AT a recent special meeting of the shareholders in the New Bedford (Mass.) Gas and Edison Light Company it was voted to petition the Board of Gas and Electric Light Commissioners for permission to issue new capital stock in the sum of $200,000, the proceeds of such issue to be devoted to the construction of a new gas plant, especially in the instance of the generating and materials' storage departments. Immediate action under the vote is not likely to occur, but it is quite certain that the reconstruction work will be commenced early in the spring.

THE betterments on the plant of the Hopkinsville (Ky.) Gas and Lighting Company have been satisfactorily completed. The bulk of the expenditure was made on the electric lighting division of the works.

JUDGE MCTAVISH has issued a decree to the effect that the rating of the Ottawa (Can.) Gas Company for taxing purposes shall be placed at $45,000 as against the figure of $75,000 put upon it by the assessment commissioners.

THE incorporators of the California Gas and Electric Company, notice of the formation of which was given a week ago, are: A. E. Childs, R. R. Colgate, E. J. De Sabla, Jr. R. M. Hotaling, L. P. Lowe, J. Martin and W. M. Pierson.

A RECENT issue of the Syracuse (N Y.) *Evening Herald* is our authority for the statement that the Semet-Solvay Company, of that city, is about to erect a by-product coke oven plant in the immediate vicinity of Cleveland, O. The further assertion is made that the plant will be of a and size sufficient to reduce 500 gross tons of coal per day.

THE following is from the Springfield (Mass.) *Republican*, dated the 15th inst.: "A. D. Merritt, Superintendent of the works of the Springfield Gas Light Company for the past 25 years, resigned his position yesterday morning, and his son, W. H. Merritt, who has been a clerk of the Company for the past 6 years, left the employ of the Company at the same time. Mr. Merritt was the last of the employees of the old Gas Company, and no one has been engaged to fill his place as yet. Albert D. Merritt has been in the employ of the Gas Company nearly 29 years, beginning work for it in March, 1873, and has been Superintendent of the works for 25 years. He was born in Warren, where he was educated in the public schools and lived till he was 18, when he came to this city and went to work for George Dwight, Jr., with whom he learned the trade of steam and gasfitting. He went to work for the Gas Company when George Dwight was at its head, and had supervision of putting in the steam plant. Since becoming Superintendent he has had charge of the construction of the entire plant as it stands at present. Mr. Merritt has trained a number of men who have taken responsible positions in gas works in several parts of the country. Among them are his elder son, A. H. Merritt, now General Superintendent of the Niagara Falls (N. Y.) Gas and Electric Light Company; A. K Wilard, who has had charge of the Greenfield (Mass.) gas works for 10 years; his younger son, W. H. Merritt, who has been in the employ of the local gas works, and Adelbert Davis, Superintendent at Ware, Mass., until he resigned a year ago on account of ill-health. Although the work of Superintendent at the Gas Company's plant is very confining, Mr. Merritt has not lost a day during his long term of service, and the longest vacation he has taken has been 7 days. His other absences have been only 2 or 3 days once a year."

ACCORDING to the St. Louis *Post-Dispatch*, in a wildly based suit filed against the Laclede Gas Light Company, of that city, by William James, a former employee, the claim is made that the Company owes the city $93,257,000 in fines for violation of the city ordinances, and that this indebtedness is increasing at the rate of $350,000 a day. James cites city ordinances requiring gas companies to submit all meters sent out to the supervisor of city lighting, and to secure his seal and stamp on the meters. Each meter sent out without such stamp of official approval constitutes a separate misdemeanor, James says, and the Company is liable to a fine of $5 for each offense. Such unstamped meters are in use to the number of 70,000, James declares, and 10 more are being sent out daily on an average. Coupled with the petition for a writ of mandamus to compel the Company to pay to the city the amount shown to be due, is a petition for the awarding to James of $20,000 personal damages for dismissal from the Company's employ. James declares in his petition that he was formerly employed by the Company to inspect meters, but that he was discharged because he did not work as fast as his superiors desired to have him. The reason for this, he said, was that his work was more thorough than that of other inspectors, and that he insisted on testing each meter, not only at the Company's offices, but at the residence of the consumer. He says he was discharged because he guarded the interest of consumers. Mr. James asks that the Company be directed to show cause why it places meters without supports on the premises of its patrons. This practice, he says, is dangerous to the lives and property of the Company's patrons. Could anything be more ridiculous than this?

THE *Gas World* reports that Mr. Thomas Goulden, at present Resident Engineer at the Gas Light and Coke Company's Beckton (London, England) works, has been appointed Assistant to the Chief Engineer of the Company. He will be succeeded at Beckton by Mr. H. Iago, at present Resident Engineer at the Company's Fulham works. Mr. Goulden was appointed Resident Engineer at Beckton in 1898, in succession to the late Mr. John Methven, and his total period of service with the Company extends to between 17 and 18 years.

ALDERMAN CONNERY, of the City Council of Chicago, is responsible for a set of resolutions that were recently adopted, which resolutions had to do with the lighting of the streets in so far as that service is performed by means of gas. The most significant item in the "resolves" came to light in the closing one, where it is declared "That it is the judgment of this Council that gas should be supplied to the city of Chicago for street lighting and other city purposes at a rate not to exceed 75 cents per 1,000 cubic feet."

SOME of the Boston papers gave voice to the "fact" that, owing to the high water in the Merrimac river some days ago, the plant of the Lawrence (Mass.) Gas Company was shut down. There was not a bit of truth in the statement, save that the waters of the Merrimac were "high." The Company's gas and electric lighting plants were not suspended for a minute, nor was any physical damage done to its properties.

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AGENTS:

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MONDAY, DECEMBER 23, 1901.

The Market for Gas Securities.

The battle of the strong that is being waged by those who occupy the seats of the mighty in the financial world shows small sign of abatement. Values are smashed, prices are cut, interest is increased and the small fry are put to the wall. All of which has reference to the amazing doings of those behind the scenes as manipulators of certain industrial stocks. Those who "coppered" copper, to use the vernacular of another class of dealers and players, have the upper hand just now; but the "coppering" process in the one specialty upset values on other shares that should have as much sympathy on copper account as a stone should have for a turnip.

Uncertainty and dread are the ruling features in the street at the moment, and while gas shares have not suffered much, it is nevertheless a fact that lack of confidence prevents them from going immediately to figures nearer their intrinsic value. Consolidated closed to-day (Friday) at 214¾ to 215¼. Other city gas shares show no change.

Brooklyn Union is inactive, and the official figures in it are 206 to 213. Peoples, of Chicago, showed much strength, but the spurt is accounted for on the ground that a certain short interest deemed it expedient to cover. At the quoted rates (101⅝ to 101¾) it is well under its real value. Washington (D. C.) gas is again above the 330 mark. Bay State is "steady," at ⅝ to ¾!

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$78,177,000	100	214¾	215¼
Central Union, Bonds, 5's.	3,000,000	1,000	109½	111
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	295	305
" Bonds	1,500,000	1,000	99	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	108¾	109¼
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River.. Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	120	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	206	213
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	⅝	¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works,. .	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	95	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7	10
" " Bonds, 5's	5,250,000	1,000	80¾	81¾
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co..	29,500,000	100	102	102½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers. Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	61¼	61⅝
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	14
" Con. Mtg. 5's	380,000	1,000	79	83
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	..	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	60	66
" Bonds, 6's	2 650,000	..	99½	101½
Jackson Gas Co	250,000	50	67	70
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	93½	93¾
Preferred	2,500,000	100	103	108
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1910	100,000	25	87	89
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	101
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	10.¾	101¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	3,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	46	46½
St. Paul Gas Light Co.	1,500,000	100	60	65
1st Mortgage 6's	650,000	1,000	112½	115
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's..	2,465,000	1,000	84	86
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	93	96
Syracuse, N. Y.	1,750,000	100	20	25
Bonds	1,612 000	1,000	91	93
Washington, D. C	2,600,000	20	330	332½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	107	108½
Wilmington, Del	600,000	50	232	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Dec 11, 1901.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 15th, 1902, to stockholders of record at the close of business, Dec. 31. Checks will be mailed.

1384-5 LEWIS LILLIE, Treasurer.

POSITION WANTED

By a Practical Gas Man, as Superintendent or Engineer.

First-class draughtsman and office man, with 20 years' experience in all branches of the gas business; designing, construction and operation. Best of references.

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Position Wanted

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Twenty-five years' experience. Best of references.

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WANTED,

Good Second-hand Exhauster and Station Meter,

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Second-Hand Apparatus, as follows:

4 Purifier Boxes, about 8 feet by 8 feet by 2½ feet.
1 Five-foot Station Meter.
1 Set Water Gas Apparatus, 4 feet or 4½ feet.

Send full specifications, plans and price, with date of delivery. Address,

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N. F. PALMER,
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MANUFACTURERS OF
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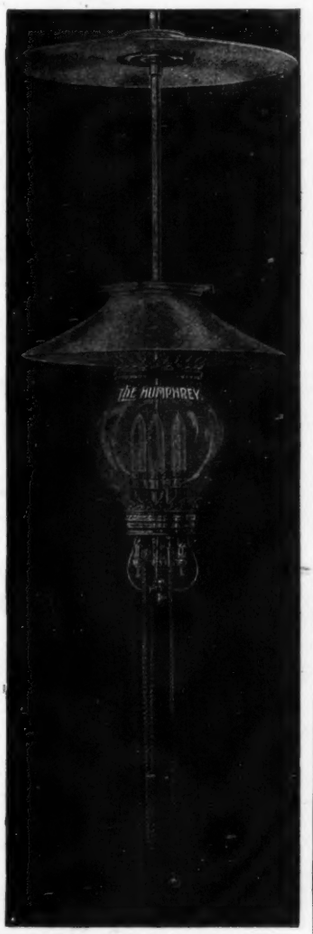

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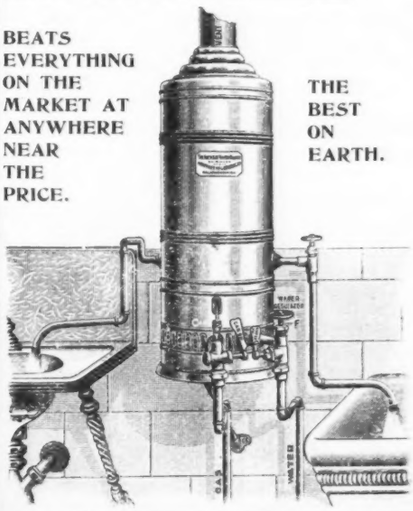

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Every Heater Guaranteed.
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KALAMAZOO, MICH., U. S. A.

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MONDAY, FEBRUARY 3, 1902.

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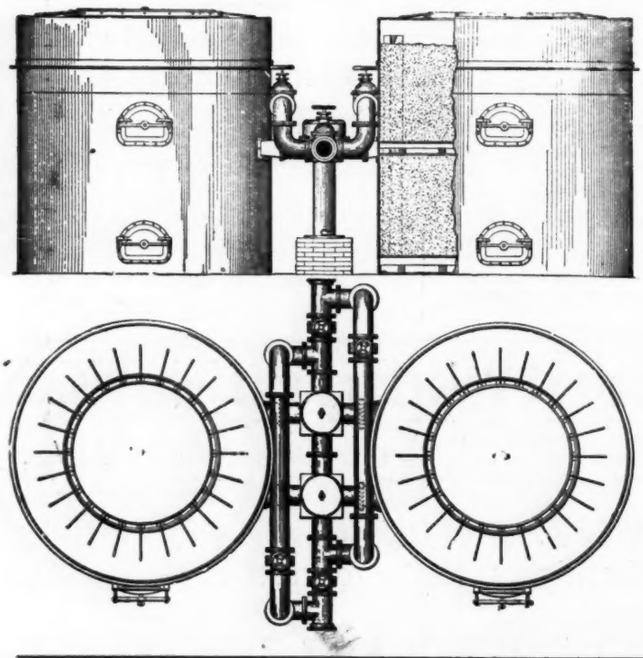

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The unauthorized use of any system or method of purification, whereby gas mingled with oxygen is made to flow in one general direction through the purifying mass, and then made to flow through the mass in a directly opposite direction, infringes the above patents!

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SOLE MANUFACTURERS,

CINCINNATI, O.

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For the Year 1900.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the Thirtieth Year of Publication.
Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Company, London.

Price $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

W. H. PEARSON, Prest. W. H. PEARSON, Jr., Vice-President. J. T. WESTCOTT, M.E., Manager. L. L. MERRIFIELD, M.Inst.M.E., Chief Engineer.

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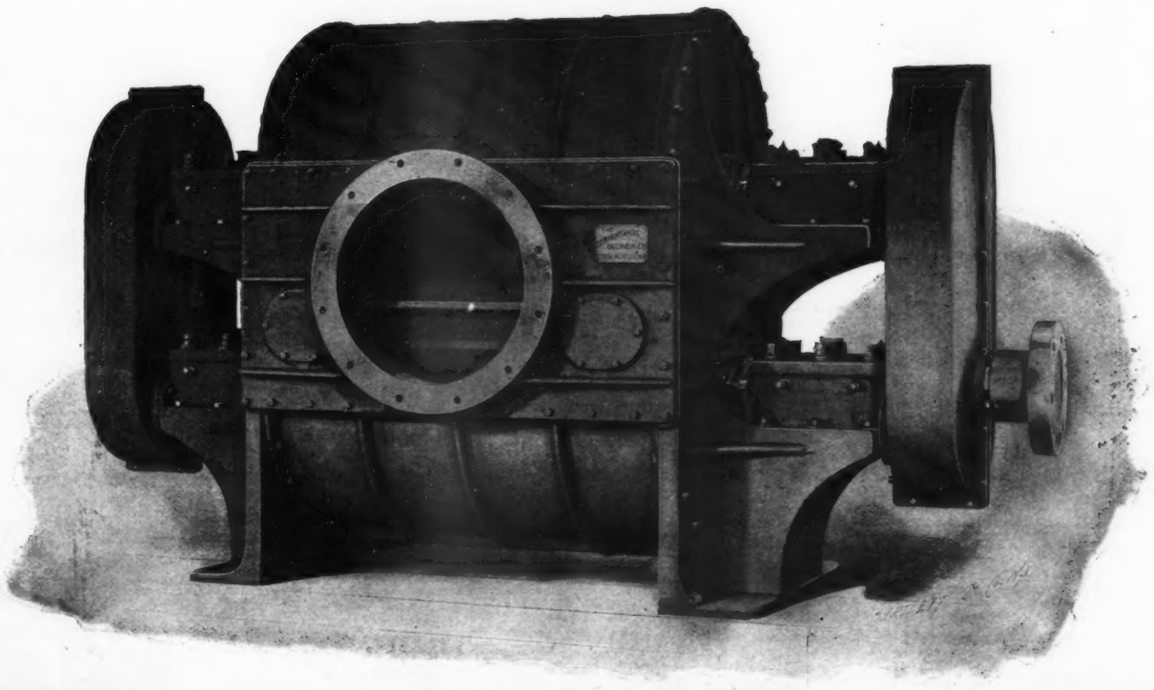
Windsor Street Works, Birmingham, England	2,000,000
Saltley Works, Birmingham, England	2,000,000
Colchester, England	300,000
Birkenhead, England	2,250,000
Swindon (New Swindon Gas Company), England	120,000
Saltley Works, Birmingham, England (Second Contract)	2,000,000
Windsor Street Works, Birmingham, England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled)	250,000
Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, England (Second Contract)	300,000

	Cubic Feet Daily.
York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
Crystal Palace District, England	2,000,000
Duluth, Minn.	300,000
Caterham, England	150,000
Enschede, Holland	150,000
Leicester, England	2,000,000
Buenos Ayres (River Platte Co.)	700,000
Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
Accrington, England	500,000
Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000
Todmorden, England	500,000
Tokio, Japan	1,000,000
Nelson, British Columbia (Complete Gas Works).	
Orders received in 1901 to March 1, 3,500,000 cu. ft. daily.	
Malton, England	150,000
Smethwick, England	500,000

THE CONNERSVILLE BLOWER CO.,

MANUFACTURER OF

ROTARY POSITIVE PRESSURE GAS EXHAUSTERS, BLOWERS AND PUMPS.



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The Pioneer Vertical Water Tube Boiler of the World.

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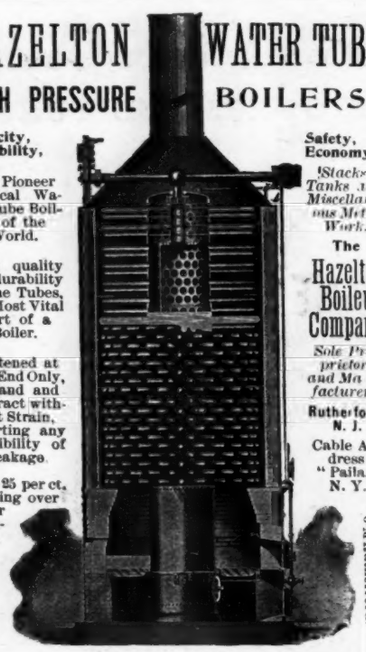

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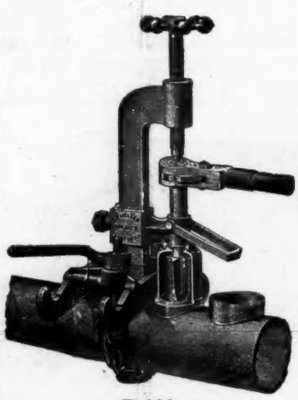

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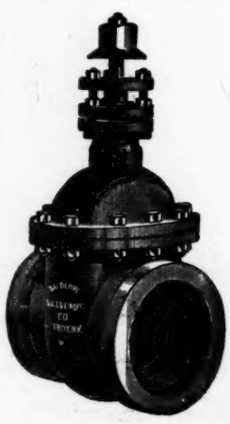

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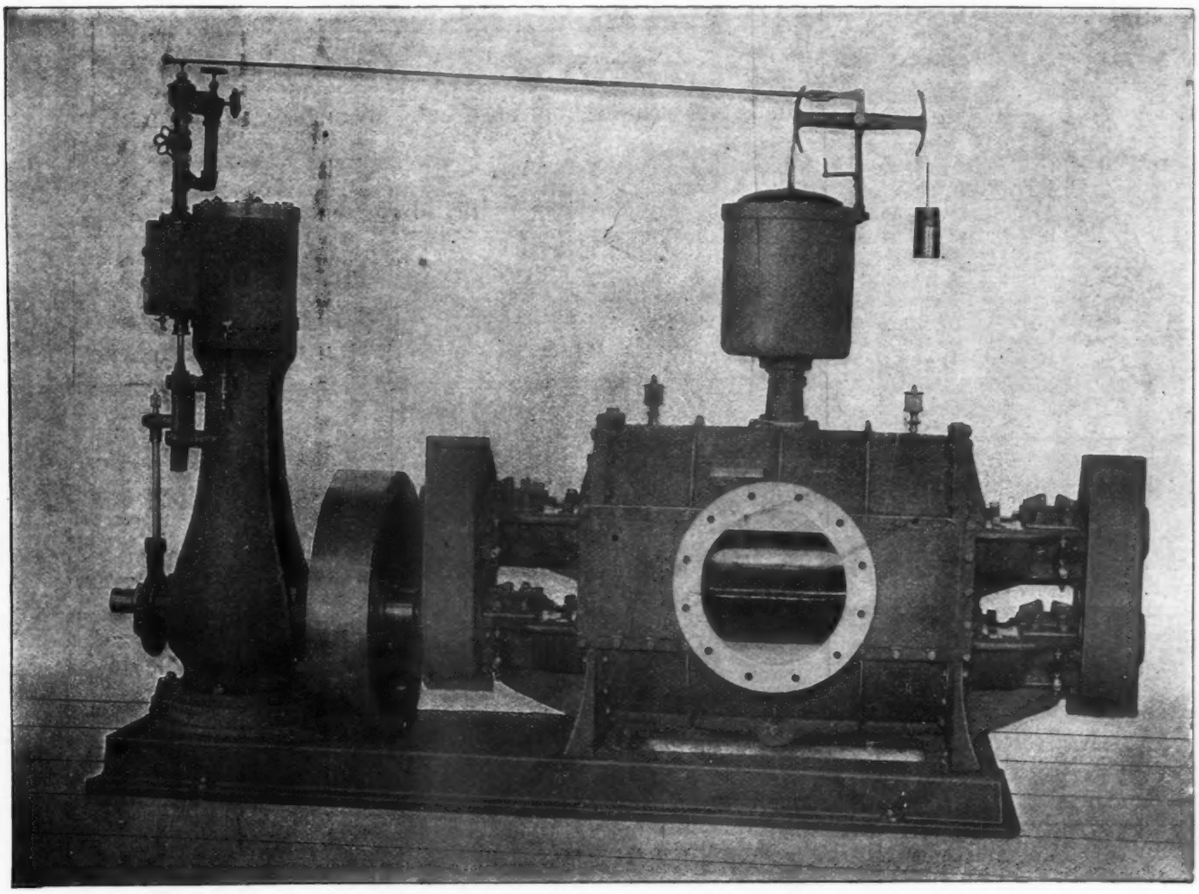

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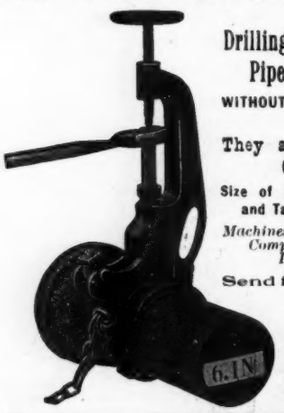

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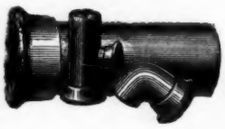

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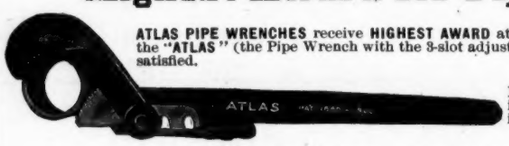
Highest Award for Pipe Wrenches.



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FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER

FOR CLEANING BOILER TUBES.

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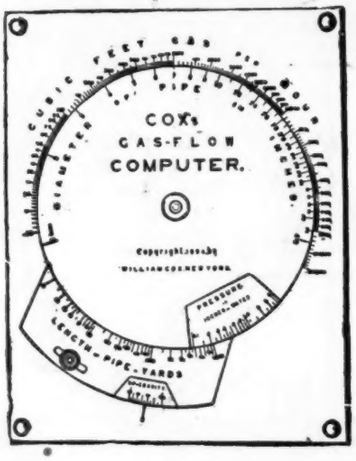

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as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

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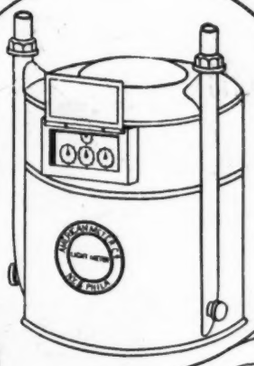

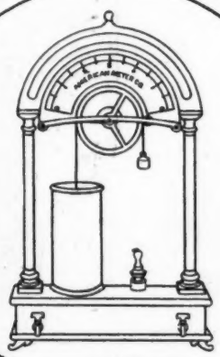

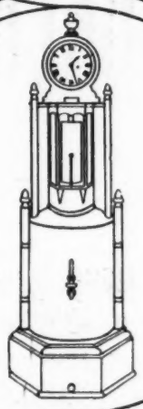

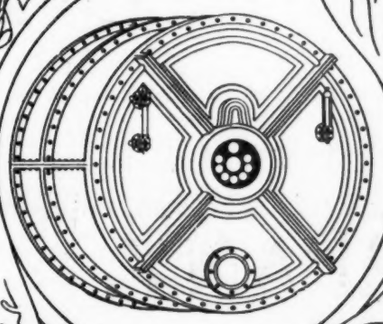

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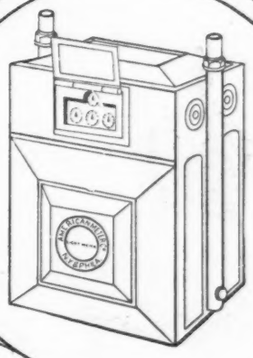
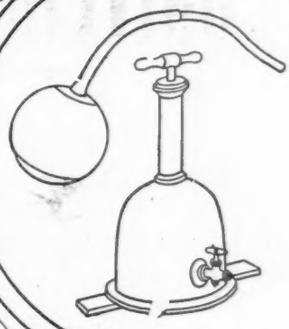
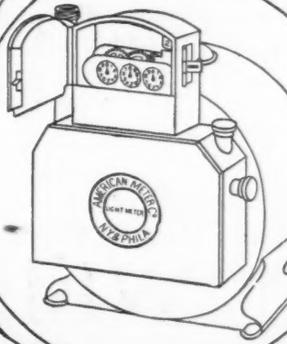






PUBLIC LIGHTING TABLE.

JANUARY, 1902.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	5.10 PM LQ	1.40 AM	4.30	6.30
Thu.	2	5.10	2.40	4.30	6.30
Fri.	3	5.10	3.40	4.30	6.30
Sat.	4	5.10	4.30	4.30	6.30
Sun.	5	5.20	5.30	4.30	6.30
Mon.	6	5.20	6.20	4.30	6.30
Tue.	7	5.20	6.20	4.30	6.30
Wed.	8	5.20	6.20	4.40	6.30
Thu.	9	5.20 NM	6.20	4.40	6.30
Fri.	10	5.20	6.20	4.40	6.30
Sat.	11	5.20	6.20	4.40	6.30
Sun.	12	5.20	6.20	4.40	6.30
Mon.	13	5.20	6.20	4.40	6.30
Tue.	14	9.10	6.20	4.40	6.30
Wed.	15	10.20	6.20	4.50	6.25
Thu.	16	11.30 FQ	6.20	4.50	6.25
Fri.	17	12.30 AM	6.20	4.50	6.25
Sat.	18	1.40	6.20	4.50	6.25
Sun.	19	2.50	6.20	4.50	6.25
Mon.	20	3.50	6.20	4.50	6.25
Tue.	21	4.50	6.20	4.50	6.25
Wed.	22	No L.	No L.	5.00	6.25
Thu.	23	No L. FM	No L.	5.00	6.25
Fri.	24	No L.	No L.	5.00	6.25
Sat.	25	5.40 PM	8.20 PM	5.00	6.25
Sun.	26	5.40	9.30	5.00	6.25
Mon.	27	5.40	10.30	5.00	6.25
Tue.	28	5.40	11.30	5.00	6.25
Wed.	29	5.40	12.30 AM	5.05	6.15
Thu.	30	5.40	1.30	5.05	6.15
Fri.	31	5.40 LQ	2.20	5.05	6.15

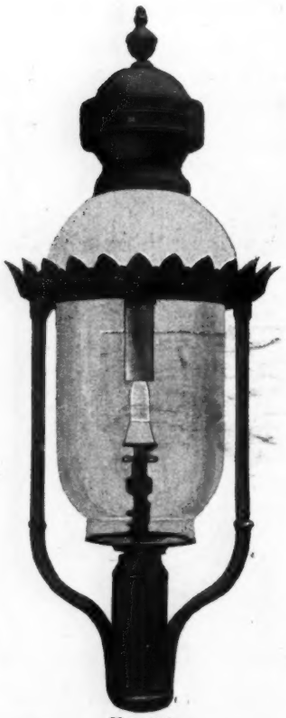
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS. 712 Roe Building. SAN FRANCISCO. 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

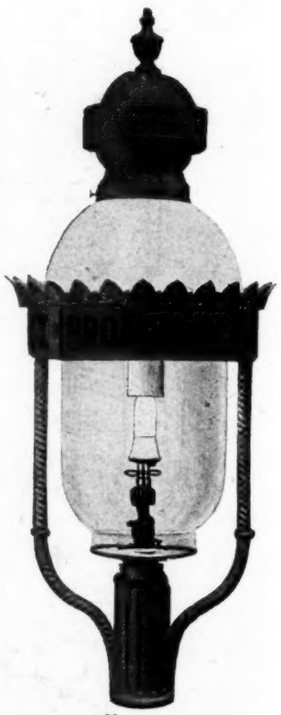
POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.



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The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

It can be used with all styles and sizes of glassware, either shades or globes. No further necessity to carry a stock of different burners for the many sizes and shapes of glassware.

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Salesrooms in all the Leading Cities of the United States.

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

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Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

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Standard Fire Brick and Gas Retorts.

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Fire Clay Goods for Gas Works.

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Clay Gas Retorts,
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Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

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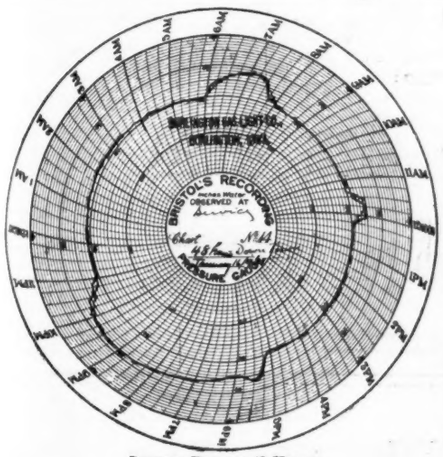

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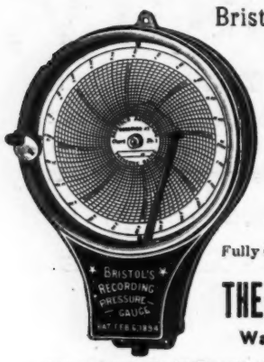

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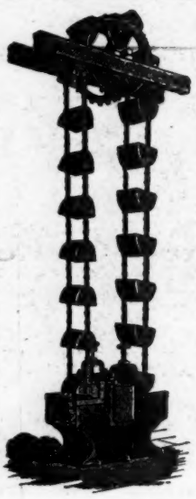

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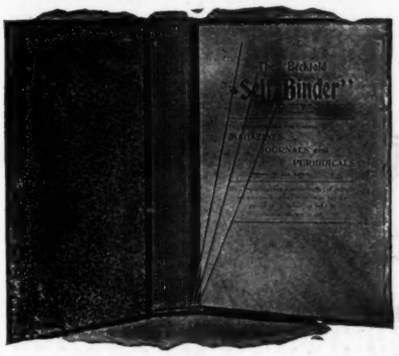

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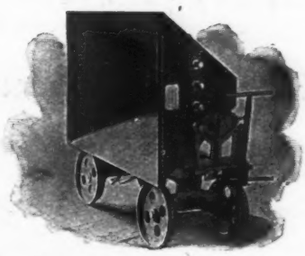

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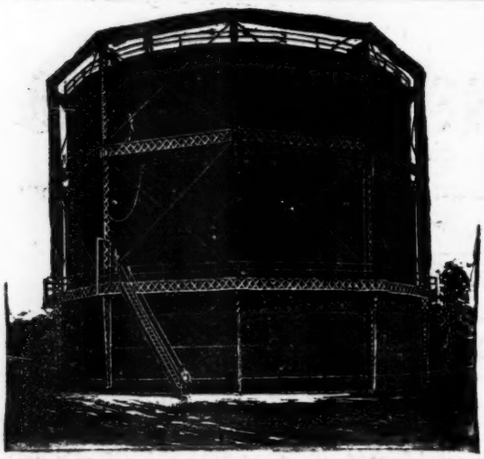

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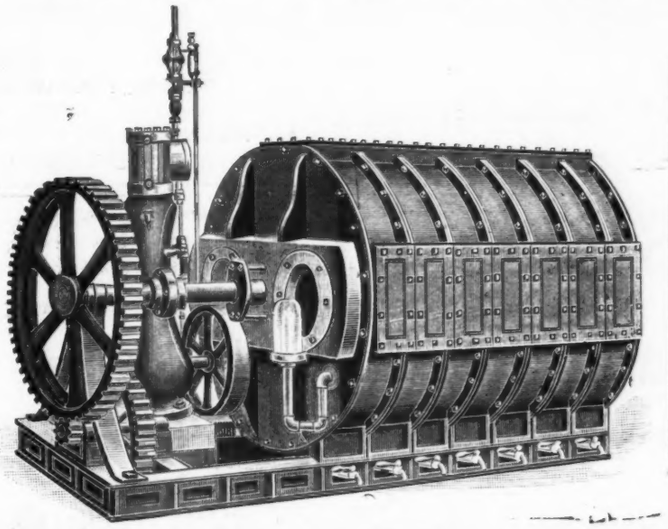

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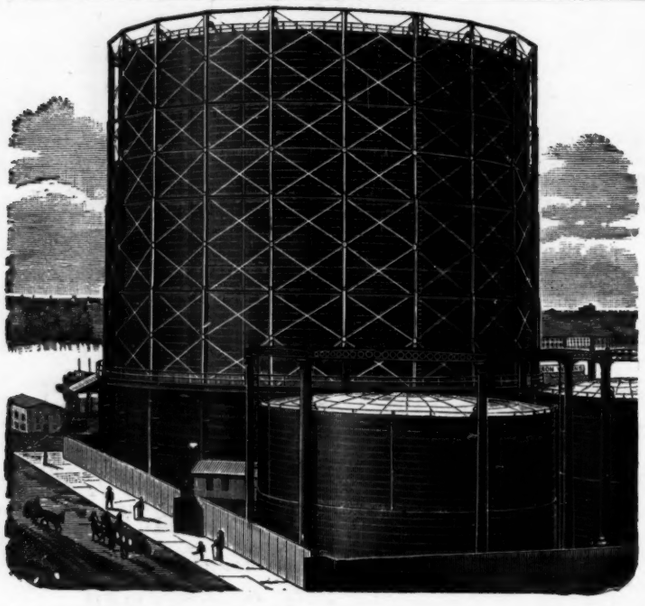

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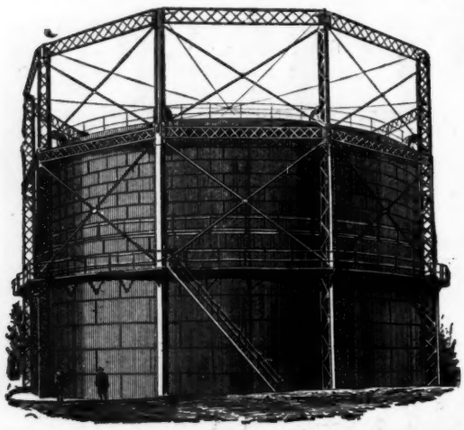

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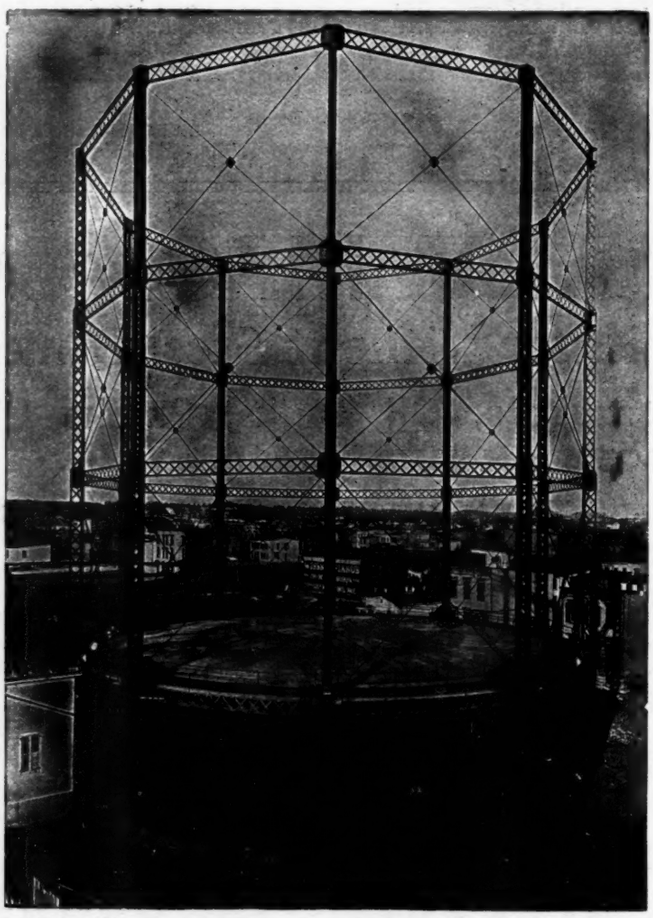

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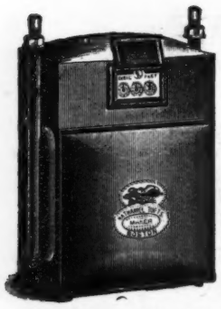

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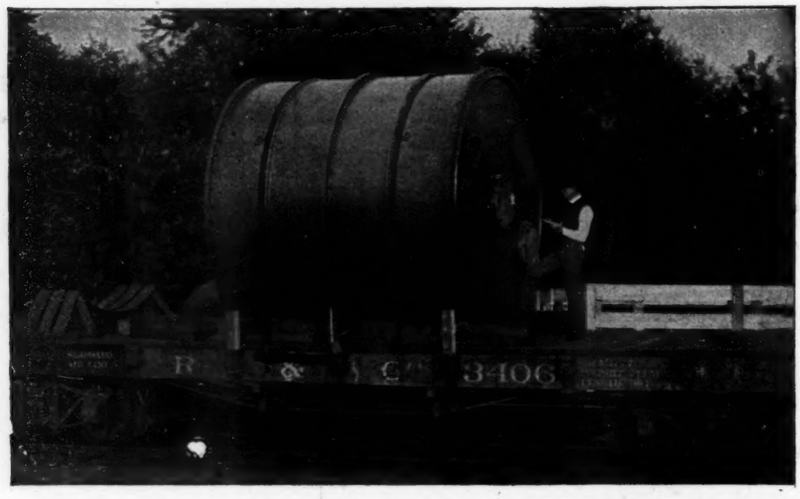

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